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INCANDESCENT LAMP TESTS HERE AND ABROAD.

A regular system for testing a certain small percentage of the incandescent lamps purchased and issued by large lighting stations was first inaugurated in the United States, in conjunction with a number of Edison electric lighting companies. At the present time the most complete system for the testing of lamps in this way is found in this country. Other countries have, however, adopted regular systems of testing incandescent lamps on demand at their national testing laboratories. An abstract of an article in the *Elektrotechnische Zeitschrift* on this subject appears in our digest in this issue. It will be seen that in Germany lamps are divided into types A, B and C, according to the watts-per-candle and to the length of life—A being the type of 300 hours to 80 per cent normal candle-power, and C being the type of 800 hours. Long tables are given in the article for the conditions of testing different types and voltages of lamps.

The conditions recognized in Germany, Austria and Switzerland, *i. e.*, in German-speaking countries, are substantially the same. The corresponding conditions in England are distinctly, although not widely, different. In the German countries, the lamp voltages run all the way from 45 to 250. This complicates the testing practice, because a type B lamp for 250 volts will consume more power than a type C lamp for 100 volts. In England there are but two standard voltages, namely 110 and 220, which simplifies the work, especially as only two types of lamps are recognized, namely, 400-hour and 800-hour lamps. In this country, we have practically only one voltage to consider, viz., from 100 to 125 volts. Our specific consumptions are usually either 3.1 or 3.5 watts per mean horizontal candle, and this permits of a still further simplification of testing practice. In our first issue of August, 1907, we printed the U. S. Government Incandescent Lamp Specifications, as adopted this year between the Bureau of Standards and the various branches of the government service. Such tests are ordinarily conducted either in New York or in Washington. Up to the present time, all of the various government specifications above considered refer to carbon filament lamps only. It remains to be seen what changes will be brought about by the introduction of metallic filaments.

CARRYING CAPACITY OF CONDUCTORS.

Judging from inquiries received relating to the carrying capacity of conductors, there is no small misapprehension as to the meaning of that expression. The belief, in fact, appears to prevail widely among those not versed in electrical principles that the data given by the Underwriters' rules specifying the "carrying capacity" of wire have a significance similar to that attaching to the data of tables of tensile strength; in other words, that the limit set by the Underwriters' table is a physical one and if exceeded by the addition to a circuit of a few more lamps, there will result serious danger from overheated wires.

The misconception is undoubtedly due to the misuse of the word "capacity." The carrying capacity of a conductor, using the expression in its broadest sense, is only limited by the melting point of the material of the wire; or in a restricted engineering sense, the term may apply to the limit of allowable drop. As used by the Underwriters, the term "carrying capacity" does not conform to either of the above criteria, the values in the Underwriters' tables being merely those of currents which, continuously existing in the given sizes of wire, will cause the temperature of the conductor to be increased under unfavorable conditions by about 18 deg. F. But another rule of the Underwriters decreases still further the "carrying capacity" of wires, namely, the requirement that a circuit branching from a cut-out shall not be connected to incandescent lamps creating a demand for more than 660 watts of electrical power. The object of this rule has, of course, no direct relation to the heating of the conductor, its purpose being to limit the amount of power available for damage in case of a break in the installation of the circuit or other fault. The Underwriters' tables of the world are based upon exhaustive experiments made about 20 years ago by Dr. Kennelly, who determined the values of the currents which, existing in insluated conductors encased in wooden molding and also strung in open air, will maintain the said conductors at a temperature of 10 deg. C. above that of the surrounding air. Except in the case of short conductors carrying large currents, such as feeders, this temperature limit usually reduces the drop below the economical point, and the low limit is still adhered to, though the wooden molding upon which it was based is a thing of the past.

Some numerical examples will illustrate the bearing of the above remarks. Taking the case of a No. 14 copper wire, the fusing current is about 250 amperes normally, but very much greater if the conductor is subjected to a current of air or is immersed in oil. If suspended in still air a current of 25 amperes will cause a rise in temperature of about 18 deg. F., or the rise will be 72 deg. F. for a current of about 45 amperes, the wire in each case having a black insulation. If the same wire is encased in wooden molding the rise in temperature is about 18 deg. for 12 amperes. The Underwriters' rules permit a current of 12 amperes with rubber insulation and 16 amperes with other insulation, except in the case of an incandescent lamp circuit controlled by a cut-out, where only 6 amperes at 110 volts are allowed. It will be thus seen that the current permitted in a conductor by the Underwriters merely limits the rise in temperature and this to a very small amount, the current being but a very small fraction of that which the same wire will carry without becoming heated to a degree near melting point, and much below what could with perfect safety be used in iron conduit. The present heating limit could with benefit and with no increase of fire hazard be considerably raised and thus made to correspond with modern methods of circuit insulation; on the other hand, if the rules should be revised, it would be wise from mechanical considerations to prohibit the use of No. 14 wire for interior wiring. In the meantime we strongly recommend that for the present incorrect head "Table of Carrying Capacity of Wires" the head "Limiting Currents for Conductors" be substituted, thus expressing what is actually meant and removing a source of much misunderstanding to many electricians and to all laymen.

Auxiliary Steam Plants.

The article by Mr. William Lee Church on this topic, printed in this issue, is one that can be read with profit both by engineers and investors. The economic features of hydraulic development are even now imperfectly understood, and there is often unreasoning prejudice against doing in the case of an energy transmission plant precisely what has been done for years in the case of mills. It is hard luck, of course, that streams now and then run very low and that occasional freshets drown out the wheels; yet one should rather be thankful for the variety of such incidents than mournful that a little use has to be made of steam. One of the chief difficulties with hydraulic power is that it is somewhat irregular. Every few years comes a season in which either the summer rainfall is greatly sub-normal or the spring floods are exceptionally severe. In the first case the flow may for a few days, or even weeks, fall far below the ordinary low-water mark; in the second, for a few few hours, or at most, days, the fall may be nearly obliterated. In some streams the former condition is the only one to be studied, but in most low-head propositions both are painfully in evidence. The existence of these periods of deficit calls for auxiliary plant if the salable power is to exceed the absolute minimum of the stream, and the length of the periods determines the proportion of steam energy that must be used.

A long-distance transmission plant frequently finds an auxiliary steam plant of great value merely as an insurance against trouble. There come times when it is very desirable to shut down a part or the whole of a plant for the readier execution of repairs to plant or line, and hence some steam reserve, preferably at the sub-station, is extremely useful, quite aside from any question of its use to help over the minima. A plant for such use should be large enough to take the whole load during its minimum hours. As such things go, the minimum load for, say, six hours is quite as much below the peak as is the longer hydraulic minimum; hence in many cases the same plant which is desirable for aid in time of trouble is also adequate for more long-continued aid in time of deficit of power. This phase of the affair is very simple and admits of little difference of opinion. It is when the development is carried so high as to call for some steam power a large part of the time that there is considerable room for its discussion. Taking the price for energy delivered into consideration, it usually turns out that every kw-hour actually delivered from steam is sold at a dead loss. It is the ability to recoup this loss by increasing the total sales of the hydraulic energy on which profit is made that is the economic justification of the steam auxiliary. Often, as in the case cited by Mr. Church, a small total amount of energy supplied from steam enables a large increase to be made in the gross earnings. In the instance given, a reserve supplying an average of 8.5 per cent of the total energy (over a period of six years) would, theoretically, double the gross income.

If this constituted the whole sum of the matter, the case would be a simple one, and the general economy of steam auxiliaries would require no further discussion. That the results are often good, Mr. Church's figures leave no reason to doubt. Yet there are some subsidiary matters that require consideration.

In the first place, it is by no means to be assumed offhand that doubling the amount of salable power will double the gross income of the plant. If the second 10,000 horse-power of output has to be sold on a narrow margin of profit, there may be trouble ahead. There is a tendency in transmission work to try to build up load too rapidly, and at a low price. It is better to lose money by not getting enough load than by getting unprofitable load, for the latter condition is the harder to remedy. If one has to cut the price much to double the load, either from lack of market or from seeking a lower-priced market as an incident to selling the larger output, there is an excellent chance of losing money if one goes too far into the steam proposition. If one is making net, say, 0.25 cents on each kw-hour of energy supplied by water, and losing 1.5 cents on each kw-hour supplied by steam, a year demanding 18 or 20 per cent of steam energy is a year of actual loss, which may be recouped later, but which is, to say the least, discouraging. Mr. Church is certainly wise in advising a cheap and simple steam plant to lessen the burden of fixed charges at times when it is not needed. Such a plant necessarily puts a heavy operating burden on the bad years, and there is a certain danger that in fairly good years the presence of a large auxiliary will serve as a temptation to take on more load than is justifiable. We have actually seen plants taking on load at prices suitable only for cheap water power when the increase forced the daily use of a very uneconomical steam plant designed simply for emergency use.

The actual cost of energy, including fixed charges, as derived from such an auxiliary is rather staggering when one comes to reckon it up. Mr. Church's long experience doubtless put him on safe ground in the case he had under consideration, but it requires a pretty good market and rather cheap hydraulic development to stand so large a use of steam as in this instance. We do not in the least criticise his judgment, yet it is necessary to suggest a good deal of caution in pushing a development up to the point that requires every few years the use of steam in large amounts for nearly half the time. It may pay and it may not, according to the circumstances. A plant ought to be able to show a reasonable return on the investment for each and every year of operation after it once gets fairly under way, in order to be what one would call a conservative investment. In most cases the deficit of power at certain times can be dealt with by less drastic means than a large auxiliary. It is not unusual to find a customer who already has a large steam plant and is willing to take at a fair price a block of power which is secondary to the extent of being at rare intervals temporarily unavailable. This is quite common practice in case of companies that sell water power as such. Again, the periods of low water generally come in the summer and early fall when load due to lighting is low, and hence a fair proportion of lighting load is highly desirable. Railway load, on the other hand, is often high at these times, and is for this reason somewhat less desirable. All this makes imperative a careful investigation of the actual market prior to settling the extent of the development especially desirable. An average requirement of 5 or 10 per cent of steam energy may be conservative or disastrous according to the local conditions. With different distributions of flow it might require a very big or a very modest auxiliary. While, therefore, Mr. Church's view of the matter is broadly correct, it takes a very thorough investigation to decide upon the actual economics of the situation.

Losses in Alternating-Current Cables.

It is well known that cables carrying alternating currents, for power transmission or distribution, do not behave so well as cables carrying corresponding direct-current strengths at the same voltage. The direct-current cables have a certain IR drop, and a corresponding I^2R loss of power; but that is all. So long as they are able to operate, their dielectric losses are negligible. Alternating currents develop e. m. f.'s of self-induction in the loop formed by the circuit carrying them, and these e. m. f.s produce a virtual increase of resistance by combining the ohmic resistance of the cable with a reactance, the vector sum of which is their impedance. The further apart the going and returning cables, the wider will be the loop they enclose, and the greater will be their reactance and impedance. A very marked increase in reactance occurs if each cable be enclosed in a separate pipe or sheathing of iron. If, however, the going and returning cables lie closely side by side, and within the same iron pipe or sheathing, their reactance will be small, and the impedance of the loop not greatly in excess of its resistance. The reactance of cables carrying alternating currents is objectionable on account of the increase in drop of pressure taking place under load. The drop increases from IR volts, the value with direct current, to IZ volts, where Z is the impedance, always in excess of R. But there is no appreciably greater loss of power on account of the reactances. The loss of power is still limited to I^2R watts, and the cable becomes no hotter on this account than before. It merely does not regulate the pressure so well.

The next item of offense on the part of alternating-current cables is their "skin-effect," or their tendency to crowd the current into the external layers of the conductor, and to leave the central portions of the cross-section unutilized. This effect virtually diminishes the active cross-section of the conductor, and, therefore, increases both the IR drop and the I^2R watts. The effect increases with the frequency, and with the size of the conductor. At the ordinary frequency of 60 cycles, the effect is negligible until the diameter of the wire exceeds $\frac{3}{8}$ in. It is usually supposed that stranding the wire, so as to limit the development of eddy currents around the axis, practically stops this effect, even in large cables, so that no attention is paid in practice to skin effects in power cables since they are always stranded in diameters above $\frac{3}{8}$ in. The next item on the docket of indictment against alternating-current cables is the loss in the dielectric, or insulating coating, due to the rapidly reversing electric stress. The cable behaves as though its insulation leakage G were much greater than the leakage to direct currents. This produces a loss of E^2G watts that heats the insulator, as though the I^2R watts had been increased. This effect does not appreciably alter the drop of pressure in the cable. In low-tension cables this E^2G loss is usually negligible, but in high-tension alternating-current cables, worked at pressures of 10 kilovolts or more, this indictment is a true bill, and the annual dielectric loss of energy may be much greater than the annual copper loss, because the dielectric loss goes on day and night uninterruptedly, whereas the I^2R loss is usually relatively small except at the peak of the daily load.

Now comes, however, from Germany and Switzerland, a new indictment of alternating-current cables. As noted in our

digest column in this issue, some tests have recently appeared in the *Elektrotechnische Zeitschrift* tending to show that the drop of pressure in fairly large stranded copper cables of from 400,000 to 800,000 circular mils is much greater than when they carry direct currents—from two to six times as great. This is when the going and return cables are laid side to side, so that the loop they enclose is very narrow, and the reactance consequently quite small. Under these conditions, a distinct small percentage increase in impedance might be looked for, but not 100 per cent or more. The author of the article attributes the increased *IZ* drop to the inductance of the spirals forming the lay of the copper strands, and the tests reported seem to indicate that the larger the spirals the greater this increase in drop. Nevertheless, we think that the case has not been sufficiently investigated, and that there is more to be learned by further research. The mere inductance of the loop in stranding seems inadequate to explain the matter. A concentric cable of about 400,000 circular mils in each conductor showed very little effect, whereas on the simple inductance theory the effect might have been expected. It is to be hoped that further experiments will be made along these lines, as the matter is of much practical importance. At all events, the tests reported indicate that in large stranded copper cables for alternating currents there should be introduced thin insulating barriers to break up the strands into bundles of not more than 150,000 circular mils each.

Dielectric Strength of Insulating Materials and the Grading of Cables.

When we realize that we have many air-insulated overhead wires that operate at pressures exceeding 60 kilovolts, whereas we have few electric cables operating at pressures exceeding 12 kilovolts, the importance of knowledge concerning the strengthening of cables under commercial limitations is made evident. A valuable theoretical paper on this subject has recently been read by Mr. Alexander Russell before the Institution of Electrical Engineers in London. In discussing the sparking distance in air between opposed sharp needle-points, the paper shows that the brush discharge from the points, which is seen in a darkened room to precede the disruptive discharge when the pressure is gradually raised, has a marked effect upon the phenomenon. Within a certain radius from the sharp points, estimated in the paper at 1 cm for a separating distance of 7.5 cms and 45 kilovolts alternating, the bush discharge ionizes the air, and renders it conducting. The result is that we are virtually dealing with two approximately spherical conducting knobs, each centered on a needle point and separated by about 5.5 cms. This shows how complicated the phenomena of the needle-gap may be, and how easy it is to obtain different results with this device, if the testing conditions differ. Indeed, the paper seems to recommend the use of spark balls in place of spark needles. The paper also points out that the effect of overstressing a simple cylindrical high-tension cable may be to carbonize the inner layers. At first thought one would naturally suppose that a cable, say, of ¼ in. internal dielectric diameter over copper strand and 1 in. external dielectric diameter under leaden sheath, would necessarily be weakened if the dielectric were carbonized for a radial distance of, say, one-sixty-fourth of an inch all around the copper strand, or, in other words, that since the rubber wall has been diminished from a thickness of 3/8 in. to 23/64 in., and replaced by electrically conducting carbonized matter on the inside shell, the carbonized cable must break down at a lower voltage. The paper shows, however, that this is not necessarily the case, and that until the diameter of the carbonized layer reaches 37 per cent of the external diameter of the dielectric, the electric stresses in the insulator may be reduced by the carbonization.

For reasons closely connected with the above conditions, aluminum is recommended as preferable to copper for some particular sizes or types of simple or ungraded cable. While this is in direct opposition to ordinary views on this subject, nevertheless the reasoning appears to be sound. An aluminum wire has a diameter considerably greater than that of an equally good conductor in copper. Consequently a cylindrical wall of rubber, or other insulator, of given thickness, must have more volume, weight and material over an aluminum wire than over the equivalent copper wire. Although that fact cannot be denied, yet if the volts per radial centimeter at the innermost layers of the insulators exceed the dielectric strength of the material, the insulator will break down and decompose in such a manner as to hand on the stress to the outer layers, where the curvature is less. The local volts per centimeter do not depend merely on the voltage across the wall and on the thickness of the wall, but also on the curvature of the wall. A flat layer of insulator, say, ¼ in. thick, will withstand a much greater voltage than the same thickness of layer bent around a small wire and, therefore, possessing a large curvature. The only way to avoid this curvature increase of electric stress in very high-tension cables is clearly either to use a copper tube or an aluminum wire for the internal conductor. In the ordinary cases practically met with, however, there is no need of a copper tube conductor since the working stresses are not excessive. An example of a cable, tested safely up to 150 kilovolts at the Milan exhibition, is referred to, in which the conductor is a copper strand surrounded closely by a thin leaden tube, 18 mm. in external diameter. The insulator consisted of three successive layers of rubber of graded dielectric constant, collectively 9.3 mm. thick, followed by a layer of impregnated paper, 5.2 mm thick. The total thickness of insulator was thus 14.5 mm, or 0.57 in. It seems likely that very high-tension cables will have to be graded cables, or composed of different successive insulating layers.

Maintenance of Lamps by Central Stations.

The constant shutting down of isolated plants by central stations and the rapid development of new electric illuminants are beginning to raise some question as to what will be the future policy of central-station companies in maintaining electric lamps for customers. At first thought, anyone acquainted with the business would say that the tendency is undoubtedly toward the more general maintenance of lamps by the central-station company. An increasing number of companies are adopting the plan of furnishing free renewals of incandescent lamps, and this has been the policy of the more progressive companies for years. Companies have also been in the habit of maintaining arc lamps for customers, and where substitutes for the arc lamp have been introduced, such as the Nernst lamp, the same practice has been followed. There is, on the other hand, a somewhat unnoticed tendency for many of the largest customers of large central station companies to buy energy by the wholesale, relieving the central-station company

of all responsibility as to the maintenance of lamps on the customers' premises. This has been done in many cases because the installation of the customer is so large as to require an electrician to look after this maintenance, and in some cases the customer operated an isolated plant before taking supply from a central station. When the central station took over the load, it was only natural for it to bid on supplying energy at the bus-bars of the isolated plant, leaving the other part of the plant to go on as before. It must be admitted, however, that except in the case of very large isolated plants, the central station has a good argument when it is able to say to the customer that he will be relieved of all trouble and expense connected with maintenance of lamps. As a matter of fact, the large central-station company is in a much better position to maintain both arc and incandescent lamps than is an isolated plant. The company purchases its incandescent lamps in large quantities under tests which insure its getting the best product and its lamps are likely to be better than those bought by the customer. It would, nevertheless, probably be surprising to learn the exact figures on the proportionate amount of the output of some of our large central-station companies which is sold wholesale to customers who look after their own installation entirely. As far as ordinary arc and incandescent lamps are concerned, the cost of renewals is so well-known to central-station companies that there is no difficulty in making a price on service with and without lamp maintenance.

Another factor which is sure to influence the situation in the next few years is the introduction of incandescent lamps costing considerably more than the regular carbon-filament lamp. The present indications are that the larger companies will start in with these lamps by giving them to customers upon the payment of the difference between the cost of the expensive high-efficiency lamp and the ordinary carbon-filament lamp. There will undoubtedly be some customers short-sighted enough at first not to pay the difference and secure the higher-efficiency lamp. On the other hand, if a company does not handle the high-efficiency lamps at all, it is likely that they will be handled by outside dealers and that a great many customers will in time purchase them for such sockets as are used the greatest number of hours a day, just as the incandescent gas mantle is used instead of the open gas jet on the more important burners in a gas-lighted house. It is not to be expected, however, that with the present activity of central-station companies in developing business, they will play into the hands of gas and kerosene competition to the extent that they let all control of lamps and lamp maintenance go out of their hands into those of the customers and the local store keepers. They have too much at stake in seeing that their customers get the most light and best service possible for their money.

BILLBOARD LIGHTING.

As we predicted some 18 months ago, the lighting of billboards and sign boards at night is becoming an important source of central-station revenue in some cities. The time will come when it will rank along with the sign business as a revenue-producer. In some cities the central station company has taken up the matter and is lighting billboards for the billboard customers at a certain rate per month, turning the lamps on and off just as under the common flat-rate sign contract. In other cities, the billboard companies have taken up the matter and are selling customers either lighted or unlighted billboards. From a commercial standpoint, billboard lighting is very much like sign and show-window lighting. It is used more hours per year than ordinary commercial lighting, and consequently involves a better load factor. It is the kind of load that helps to make a central station earn a larger percentage on its investment. There is nothing particularly new about the commercial questions involved, as it is simply a different form of sign and display lighting.

The engineering side of billboard lighting presents some interesting problems. The great part of billboard lighting by incandescent lamps which has been done up to the present time is accomplished in a very inefficient manner. It has usually been the case that when the contract is taken for billboard lighting, the man having it in charge must put up quickly some sort of illumination equipment, utilizing what is most conveniently at hand and without going into a scientific study of the problem. The lighting of a billboard with a row of incandescent lamps without wasting a large amount of light is not by any means easy, although it may appear simple at first sight. Efficient billboard illumination means that the light which is given out in all directions from a row of lamps must be efficiently reflected so that the flux of light is confined to the comparatively small angle covered by the billboard. It is the show-window lighting problem in a much more difficult form, for the lamps and reflectors must withstand the weather, and, as far as possible, the stones thrown by the mischievous boy. Furthermore, the light must be confined within a narrower angle than in a show window, and in order to avoid excessive light at the top of the board and insufficient light at the bottom, the distribution must be carefully planned to give a very high candle-power in the direction of the bottom of the board and much less near the top, if the lamps are to be placed at the top, as is usually the case.

No common form of painted trough or cone meets these requirements, either as to efficiency of reflection or proper distribution of light. Where some of the lamps can be placed below the board, as is the case when it is installed on roofs of buildings, the reflector problem is considerably simplified. The flaming arc lamp, when hung high above a 25-ft. billboard, gives excellent results. On account of the lavish quantity of light obtainable from a flaming arc, one does not need to be so particular about utilizing it efficiently, as with incandescent lamps. Consequently, even though considerable light is wasted by an inefficient shield, it still has a great advantage in efficiency. A shield on the side of the lamp away from the board should always be used to keep the light from shining in the eyes of those who are trying to read the board. The principal point to be avoided in the use of flaming arc lamps for this purpose is to hang them at such an angle with reference to the board that the glare of regular reflection from the paint will not prevent ordinary passers-by from reading what is on the board. In other words, the angle from the arc to the board should not equal the angle from the board to the passer-by. The use of flashers for lighting and extinguishing the lamps at regular intervals is even more effective in the case of billboards than in the case of electric signs. Such flashers reduce the cost of energy necessary for incandescent-lighted boards considerably, and reduces the disparity between the efficiency of the incandescent lamp and flaming arc.

Hydro-Electric Development in North Carolina.

The Whitney Power Company has just begun work on a power house designed for the generation of 46,000 horse-power for distribution throughout the Piedmont section of North Carolina. The plant is situated on the Yadkin River, near Salisbury, N. C., and is one of the largest power developments undertaken in the South. The power building will be of concrete and have a floor plan of 90 ft. x 260 ft. A large amount of canal excavation remains, but six steam shovels are now at work and 20,000-lbs. of dynamite in one section will mark the final blast along the canal, though there will be touching up along its course for some time. From the crest of the dam to the tail race there will be a fall of 130 ft. The flumes for the six turbines are 700 ft. long by 12 ft. in diameter. A derrick has been raised and the current of the river is being changed by a coffer dam to enable the work of excavation to begin. The railroad has been extended from Whitney, N. C., below Palmer Mountain, where the power house it to go up, and daily materials for the building of the power house are being hauled.

The T. A. Gillespie Company has the contract for the development, and, so far, built, a road over 10 miles in length, has moved 2,000,000 cu. yds. of dirt and put 400,000 tons of granite in the greatest dam in the Southern States.

The energy generated at the Whitney plant will be furnished to manufacturers in Lexington, Thomasville, Greensboro, High Point, Charlotte and many other towns within its range of distribution. The total cost of the plant will be about $5,000,000. The headquarters of the company are at Salisbury, N. C. Surveys have been made and plans adopted for two other plants in the same neighborhood, which will produce 90,000 horse-power. The Whitney Company has laid out a town of 600 acres near the power house and is offering special inducements to manufacturers. The company has its own granite quarry, four miles from Salisbury, N. C., where all the stone required in construction is being obtained. It also owns some 10,000 acres of land in Rowan County and expects to spend large sums on development.

Mr. Gillespie states that the Whitney Company will also develop a fall four miles below the narrows and erect another plant capable of generating 40,000 horse-power.

Consolidation of Lighting Interests at Baltimore.

A consolidation has been effected of the electric lighting and power interests in Baltimore, by which the Baltimore Electric Company passes into the control of the Consolidated Gas, Electric Light & Power Company of that city. There is a probable further change of ownership involved as to the Maryland Telephone Company, controlled by the Baltimore Electric Company, which is now negotiating for its transfer to the Bell interests in the Chesapeake & Potomac Company. Mr. S. Davies Warfield, who has conducted the negotiations, has issued the important and interesting statement given below as to the nature and terms of, and the reason for, the merger in question:

"The Consolidated Gas, Electric Light & Power Company has taken a lease of the property of the Baltimore Electric Company. The lease will run for 999 years, and under its terms the Consolidated company will pay to the Baltimore Electric Company an annual sum equal to the interest on the bonds of that company outstanding and to interest on its outstanding 5 per cent preferred stock, provided that company does not earn these requirements. It must be understood that the securities on which interest and dividends are thus provided for represent actual cash invested in the properties of the Baltimore Electric Company. The electric light and power business of the Baltimore Electric Company will have $2,295,000 of bonds on which to pay interest after deducting the income received from other sources. There is $1,000,000 of preferred stock.

"It has been known by all familiar with such matters that electric energy has been sold in this city at a price below the cost at which it could be produced, and far below that at which it is sold in any other city of the United States where it is produced under similar conditions. It could therefore only be a question of time when these companies must either have privately agreed on a uniform rate or one company pass under the management of the other. It has been my belief that agreements on rates or division of territory between companies operating in the same field were unwise and any proposition of this description was, therefore, never considered.

"I am a believer in the development of the electric field in and around Baltimore. I believe that in supplying abundant electric energy for industrial purposes the development of the manufacturing interests of this city will receive an impetus impossible to be obtained from any other source. All this requires large outlays of money. This money is secured by the sale of the securities of these companies. You cannot sell the securities of a company to advantage when that company is forced to sell its product made by the use of money received from the sale of its securities at a price less than it cost to produce that product. Therefore, when a community secures electric energy at less than its cost of manufacture the effect of compelling such a destructive policy is to stop the investment of money in providing the essentials for the manufacturing or business growth of a city. The result of such a destructive policy was to produce a deficit in the operations of the Baltimore Electric Company from the electric portion of its business after paying interest on its bonds, which, of course, is now to be stopped by receiving a reasonable rate for energy.

"The leasing of this company is but one step in the plans for the development of the electric field. The Consolidated Company has at Westport one of the largest and best equipped electric power stations in the country. As is known, arrangements have been completed with the McCall Ferry Power Company by which the Consolidated Company is to receive a large amount of electric energy generated on the Susquehanna River. The energy from the river will be conveyed therefrom to the city boundary, where it will be turned over to a distributing company. For this purpose all the stock of the Maryland Securities Company has been acquired. This was formerly owned by interests identified with the Baltimore Electric Company, and comes to the leasing company by the purchase of its stock.

"The Maryland Securities Company, which will form the basis of distribution of this river power, will be the company which will own the common stock of the Baltimore Electric Company, which has now been purchased. All the capital stock of the Maryland Securities Company will, of course, be owned by and held in the treasury of the Consolidated Gas, Electric Light & Power Company. In the general plans outlined there are no promotion stocks, no increase or exchanges of securities. Only the machinery necessary to properly conduct a business of the magnitude as that contemplated has been provided. The direct benefits from these various sources will belong to the Consolidated Gas, Electric Light & Power Company.

"Through the Maryland Securities Company the large users of electric energy for manufacturing purposes, located principally in Baltimore County and around the city, will receive their supply, while the commercial motor service within the city and energy for electric lighting will be supplied by the Consolidated Company and the Baltimore Electric Company.

"As stated, under the contract with the McCall Ferry Power Company, the Consolidated Company will sell to that company energy generated from steam at its stations at times when the steam stations of the Consolidated Company are not necessary in the operation of its own business, to enable the McCall Company to make what is called permanent power out

of what is termed non-permanent water power on the river. Thus will be seen the relief service the Consolidated Company will have to offer its patrons. It will have a large supply of power from the Susquehanna River; it will have the product of the large, steam-driven power station at Westport and substations, and with the newly acquired property it will now have the modern station of the Baltimore Electric Company.

"Under the proposed plans for operating the Baltimore Electric Company in harmony with the Consolidated Company and using energy from the Susquehanna River, a broad and comprehensive system for supplying this city and suburbs with electric energy for lamps and motors can be completed, and the immense outlay of money necessary to its success can be obtained when purchases of bonds for extensions and improvements can be assured of safe investment for money paid the companies.

"In this connection I might state that the management of these companies have full regard for the rights of the public and the duty of these companies to the city and to the people. Unreasonable rates shall not be charged and I am able to state as a result of the plans developed and developing and briefly outlined, the people of Baltimore shall be able to purchase electric energy at a price lower than that charged in any of the large cities of this country. It will be the policy of the Consolidated Company to maintain prices below those of the other cities.

"To enable this to be done we must ask fair treatment from the city and state in the matter of taxes. If the people are to have the benefit of cheap light and power we must be given the benefit of at least reasonable taxes. The taxes now paid by the Consolidated Company are about 9 per cent on the entire gross receipts of that company. That company now turns over a larger proportion of its gross earnings to the city and state in taxes than any corporation doing a similar business in any of the large cities of the country."

Boston Edison Rates Defended.

A final hearing was held by the Massachusetts Gas & Electric Light Commission on Nov. 26 in relation to the Public Franchise League petition for an equalization of rates charged by the Boston Edison Company. Mr. E. W. Burdett for the company emphasized the point that of its 30,000 customers but a mere handful appeared to express dissatisfaction. The earnings of the company are reasonable, amounting to practically 5 per cent on its investment. Many authorities and court decisions were cited to show that a differential in rates was not only justified but required whenever there is a difference in the cost of supply.

Mr. Burdett stated that "the commendable purpose of the organization which brings about the complaint is alleged to be to help to bring about fair and friendly relations between the public service corporations and the people. The confidence and approval of the thinking men in the community is the breath of life to such corporations. The time for the display of corporate arrogance toward the public has long ceased to be. The company must in its own interest seek to retain the confidence and respect of the public which it serves. In doing so it must not permit itself to be swayed by popular clamor into the abandonment of sound business principles. It cannot seek popularity if thereby it invites ultimate disaster. For the mere sake of seeming to go right it must not in fact go wrong. It has a right to rely upon its superior knowledge of the principles and practice of the industry in which it is engaged. The Edison Company has a larger consumption of its product per capita and a wider distribution of its service among possible customers than in any of the other cities with which is has been compared, and the alleged widespread dissatisfaction with its prices and methods does not exist. The company seeks the affirmative endorsement and commendation from the commission and public which it believes it merits."

Secretary Eastman of the Public Franchise League concluded by urging that a flat and fixed rate per kw-hour should be charged all customers. The league believes in a sliding scale system, but thinks that the time is not ripe for its use in electric lighting. The board took the matter under advisement.

Changes in National Code Recommended by Inspectors.

At the convention of the Western Association of Electrical Inspectors, held at Hotel Ryan, St. Paul, Minn., Oct. 22, 23 and 24, 1907, action was taken on recommending a number of changes and additions to the National Electrical Code. Out of 73 proposed amendments recommended by the committee, 24 were acted upon favorably and will be urged upon the electrical committee of the National Electrical Association for incorporation in the National Electrical Code. Some consideration was given to a rule prohibiting the use of molding. This, however, was not among those finally adopted by the association and recommended for the national code. It was recommended that a note be incorporated in the code recommending the use of nothing but conduit in show windows.

The following rules and additions were also recommended by the association:

A rule forbidding the dead-ending of a 4½-ft. run on a cleat-type socket or rosette.

A rule requiring petticoat insulators or waterproof conduit on all interior work where water collects or condenses.

Add specifications for waterproof sockets and fixtures in damp places.

Require manufacturers to furnish as a component part all portable fans, etc., a certain length, say 10 ft., of approved portable cord.

A requirement for lamp bases to be protected from accidental contact by persons handling the lamp.

Require wiring in refrigerating rooms, paper mills and other locations exposed to dampness to be in drained conduit or on petticoat insulators.

Rule 3-b. Strike out all words after the words "Non-combustible material."

Rule 3. New classes requiring switchboards to have main switch, main cutout, ammeter, voltmeter and ground detector.

Rule 12-g. Change the last sentence of the fine print note so as to read: "The outer or weather end of conduit is to be provided with an approved device having wires separated and bushed through porcelain."

Rule 13-a. Make grounding of transformer secondaries compulsory when primary exceeds 550 volts. (A number of public service corporations protested by telegraph against the approval of this amendment.)

Rule 14-b. Add following sentence: "For wires smaller than No. 8 B. & S. split knobs shall be used and tie wires and knobs will not be approved.

Rule 14-c. Add a note to indicate a method of insulating a splice on low potential work which would be approved.

Rule 14-c. Omit fine print note as some joints are now approved for use which do not require soldering.

Rule 14e. Omit last sentence which gives inspector power to permit wires in contact with pipe.

Rules 18 and 20. Do not allow the use of series arc lamps.

Rule 22-a. Provide that service switches shall not be less than 25 amperes capacity.

Rule 24-a. Fine print note. Specify what are approved barriers for 300-volt work.

Rule 24-n. Permit use of slow-burning weatherproof insulation in conduit exposed to heat in dry places.

Rule 24-u. Require "Flexible tubing at combination fixtures to be fastened by tape or otherwise to the gas pipe."

Rule 26. Add a requirement for movable canopies so as to permit inspection of splices and insulating joints.

Rule 45. Add a new section giving specifications for approved stage cables, such as are required by the theatre rules.

Rule 54-c. Add this sentence: "Flexible tubing may be used as bushings if run in continuous lengths from the last porcelain support outside to first one inside the box or flush up to base of fittings, i. e., cut out or switch.

Legal Readjustment of Rates at La Crosse, Wis.

The following main points of interest in the decision of the Wisconsin State Railway Commission in respect to the application of the La Crosse Gas & Electric Company for the right to charge higher rates for electrical energy are worthy of attention because of the issue involved. The testimony and facts presented by the petitioner relate mostly to the history of electric lighting in La Crosse, to the character and capacity of the electric plant; to the earnings and expenses of the company for the past 5½ years; to the assets and liabilities of the same period; to the rates which the company was asked to establish; to the various systems of fixed rates that are now in use, and to many other questions that are involved in the case.

From the facts relating to the value of the plant and to its earnings and operating expenses, the Commission says it is quite clear that the plant has not been a conspicuous success as a producer of net earnings. This is especially true when some allowance is made for depreciation at 3 per cent. During the past two years, the net earnings were not enough to meet ordinary depreciation charges, much less any interest upon the investment; and so long as the rates charged for energy remain as low as at present there is but little hope that the net earnings will increase. The decision takes up one of the most important features of the problem—the cost to the company of serving each class of customers. On this point the Commission says:

"When the fixed expenses are prorated upon the total kw-hour capacity of the plant, which was 10,950,000, and the variable expenses are prorated upon the actual kw-hours sold, or upon 1,705,118, the cost per kw-hour for the consumer who consumes energy or who uses his lamps 24 hours daily will be found as follows:

"Fixed expenses, 0.83 cent per kw-hour; variable expenses, 2.87 cents per kw-hour; total, 3.60 cents per kw-hour. When the fixed expenses are prorated upon about 4.17 per cent of the total capacity, or upon about 456,255 kw-hours, and when the variable expenses are prorated upon the kw-hours sold as above, the cost per kw-hour for the consumer who uses his lamps only 1 hour per day will be found. It is approximately as follows: Fixed expenses, 19.90 cents per kw-hour; variable expenses, 2.87 cents per kw-hour; total, 22.77 cents per kw-hour. If the expenses are separated, between fixed and variable on the other basis outlined above, that is, if rental, depreciation, interest and certain other items are divided between both the fixed and variable expenses, instead of being classed as fixed expenses entirely, the results will be somewhat different from those already presented. In that case the cost per kw-hour would probably be close to 5.50 cents for those who used the energy 24 hours daily, and not far from 15.50 cents for those who use the lamps about ½ hour per day only."

The difference in the cost to the corporation in serving patrons for a longer or shorter time per day is then shown to be as follows:

"The respective total costs for 2, 3, 4, 6 and 8 hours' use per day are as follows: Two hours daily, 11.48 cents per kw-hour; 3 hours daily, 8.48 cents per kw-hour; 4 hours daily, 7 cents per kw-hour; 6 hours daily, 5.50 cents per kw-hour; 8 hours daily, 4.74 cents per kw-hour."

Referring to the new schedule, favored by the company and established by the Commission, the state body says:

"In fact, the schedule itself, which can almost be said to be a combination of the 'readiness-to-serve' and the 'maximum demand' methods, is so made up that it appears to meet fairly the requirements in this case. This is significant. It constitutes a strong argument in favor of its adoption. As intimated, however, the adjustment to the cost is not uniform for all the rates. The highest rates in the schedule, for instance, or those for 60 hours or less per month, are somewhat lower than the indicated cost of the services rendered to these classes of users. The reason for this, however, is not found in the faulty method of computation, but in a city ordinance which limits the maximum rate to 10 cents per kw-hour. Now it so happens that the cost for the 1-hour and for 1½-hour consumer is greater than 10 cents. Even those who use the energy equivalent to 2 hours daily may almost be included in this class. Under the proposed schedule, therefore, the short-hour customers, who comprise mostly the residence district, will contribute relatively less to the revenues of the company, when measured by the cost, than the long-hour customers. This is an inequality, however, that it is difficult to adjust so long as the present ordinance remains in effect. It is, of course, possible that it may be obviated by radical improvements in the methods of operation or production, but the chances for this are rather remote."

"Some of the rates for energy for motors, as given in the schedule, may appear to be lower than warranted by the cost in these cases. It is true these rates are quite low, but it is not clear that they are unprofitable. Upon an examination of the facts it will be found that there is a great deal to be said in favor of comparatively low rates for energy for motors. The maintenance charges for the distribution of energy for motors are lower than that for lamps. The consumption of energy, both as to maximum demand and hours used, is also much greater in the former case and this materially reduces the cost per unit. The energy for motors is produced during that part of the day when little or no lamps are used, or while the plant is simply holding itself in readiness to supply such demand for lighting as may be made upon it. There may also be sharp competition between the electric plants on one hand and steam and gasoline plants on the other. For these and other reasons it is customary everywhere to grant much lower rates for energy for motors than for lamps."

That the new schedule of rates is lower than those in effect in any other city within or without Wisconsin, is held. The decision says:

"It further appears that the proposed rates are somewhat lower than those charged in other cities, both inside and outside of this state. The comparisons we have made upon this point are quite extensive. They embrace at least 20 cities in Wisconsin and fully as many in other states. These facts are of considerable importance, not only to the petitioner, but the people who are served by this company.

"The petitioner has duties as well as rights in this matter. While it is entitled to reasonable rates for services it renders, it has not the right to exact more than this. It must also see to it that the services it renders are adequate and that they meet all reasonable requirements in this respect. It is as important that the interests of the public it serves should be as fully protected as those of its own. The best rates are those that are based upon the cost. Each customer should under ordinary conditions contribute his just proportion of all the expenses, as well as of the interest upon the investment.

"From the foregoing examination of the facts involved in this case it appears to us that the rates submitted by the petitioner fairly meet the situation, and that they are just and reasonable. It has been determined, therefore, that these rates shall be put into effect, subject, however, to such revision as may be found necessary when the plants in question have been appraised, or for other reasons. The causes which led to this application, and because of which an increase in the rates is authorized, are of such character as to bring this case within section 99, chapter 499, laws of 1907, which provides for emergency rates under certain circumstances. As soon as practicable after the appraisals of the plant, which have been decided upon, have been made, it is our intention to continue this investigation. Any of the rates in the order herein which are then found to be in a respect unreasonable will be promptly adjusted upon a fair and equitable basis. It is, therefore, ordered that the petitioner in this case, the La Crosse Gas & Electric Company, in lieu of the rates it now charges for electric energy for motors and lamps, shall substitute the following maximum rates:

"The service charge on all lighting and installations shall be $1.80 per year per 16-cp lamp, or equivalent demand, one-third of connected installation, or when one-third of the con-

nected installation is considered to be the demand. The meter rate for a consumption equivalent to 60 hours or less per month per each installation shall be 7½ cents per kw-hour. The meter rate for a consumption equivalent to more than 60 hours per month per each installation shall be 6 cents per kw-hour. The meter rate for 'patrolled service,' or for signs and other installations with fixed hours of use, shall be 5 cents per kw-hour.

"The service charge for motors shall be $27 per year per horse-power demanded. The meter rates for less than 5 hours per day per horse-power demanded shall be 5 cents per kw-hour. The meter rate for over 5 hours, but not exceeding 10 hours, per day per horse-power demanded, shall be 3 cents per kw-hour. The meter rate for over 10 hours per day for horse-power demanded shall be 2 cents per kw-hour."

Lightning Protection.

Dr. C. P. Steinmetz lectured before the Chicago section of the American Institute of Electrical Engineers, Nov. 26, on "Lightning Protection." The meeting brought out the largest crowd of electrical engineers that has been assembled in Chicago for many years. Dr. Steinmetz related the history of lightning protection for electric circuits. The necessity for lightning protection of electric circuits was first felt on telegraph lines. On these lines the problem was simply solved by placing a spark-gap so as to shunt lightning discharges to ground before they reached instruments and apparatus. Circuits carrying electric energy, however, required different treatment. Besides being able to divert lightning discharges to ground, they must be made to interrupt the current from the generator after the lightning discharge had passed over the spark-gaps. On direct-current circuits, the problem of interrupting the current from the generator was solved by the use of magnetic arc rupturing devices which blew out the arc as soon as it was fairly established. For alternating-current circuits, use was made of the horn arrester principle, where the arc was ruptured by traveling upward between a pair of horns which gradually increased the length of the arc until the air currents blew it out.

The next step in lightning arrester development was the result of investigations by Wurts with non-arcing metals. A number of spark-gaps were placed in series between the line and the ground. Such spark-gaps, consisting of cylinders of non-arcing metal, have the characteristic of requiring high voltage to reverse the arc, so that the arc is extinguished at the zero point of the alternating wave. Such non-arcing multi-gap arresters worked well with small dynamos, but with large power stations they burned up. While such arresters protected against lightning discharge, they would short-circuit and shut down the system in doing so.

The arrester problem is one of opening the circuit without shutting down the system. One method of doing this which was tried was to put a resistance in series with the spark-gaps. One company which made arresters with series resistance proved theoretically that this series resistance was not detrimental and that it allowed discharges to pass freely to earth. Another provided no series resistance and talked of the advantages of allowing unlimited discharge current to pass to earth. The next year both companies reversed policy. The next step was to provide a shunt resistor around some of the spark-gaps of an arrester. In this construction, the voltage required to establish a discharge to earth is only that necessary to jump the spark-gaps between ground and the point where the resistor is connected. Should the discharge be of sufficient volume to establish across the shunt resistor a voltage great enough to jump the spark-gaps in shunt with it, a part of the discharge will pass to earth without going through the shunt resistor. The arc established on the upper gaps in shunt with the resistor is very unstable, and extinguishes itself easily.

The difficulty experienced with the shunted arrester was that if a low resistance were used, it would be safe as to the volume of the discharge it would pass, but discharges of large volume frequently repeated would explode the resistor. If the resistor was made of wire, it would burn out. If it was a mixture of clay and graphite, the resistance would be very changeable. The difficulties with clay and graphite resistance mixtures led to the introduction of a more satisfactory resistor, namely, cast-silicon, which has about 10,000 times the specific resistance of copper.

A further development of the shunted multi-gap arrester consisted in the use of several resistors. A resistor of low resistance of considerable current-carrying capacity is shunted around a small number of gaps, an additional resistor of higher resistance of less current capacity is shunted around more gaps, while a third resistor of very high resistance is shunted around the greatest number of gaps. Minute discharges pass over the high resistance, and through the small number of spark-gaps to ground. Heavier discharges will cause voltages which will jump a larger number of spark-gaps and allow discharges to pass through the resistors of lower resistances. This arrester has a great range and is very succesful when the resistor of low resistance is indestructible. It is not good for very large interconnected systems.

Dr. Steinmetz called attention to the fallacy of the triangular arrangement of insulators and transmission lines on iron pole lines. The top conductor, in such a case forming the highest point on the line, can not be protected, as it is located on the top of a lightning rod at the very place to be struck by lightning. A lightning rod carried up from the iron pole to a point above the uppermost wire is a little better than nothing, as in such a case, if the pole were struck by lightning, the insulator may not be shattered, but the lightning discharge will ground the line. The systems in which there is a large amount of underground construction are susceptible to troubles from operation similar to those caused by lightning, because of the electromagnetic and electrostatic energies which are stored in the normal operation of an electric circuit. Circuits with capacity and inductance are, in some cases, susceptible to great voltage rises, owing to their electromagnetic energy and the effect of suddenly interrupting the flow of this energy. The destructiveness of this "internal lightning" increases with the size of the system. These phenomena are always oscillatory in character, and may have a frequency of from ninety to many hundred million cycles per second. The higher the frequency, the less the power and destructiveness of the discharges. The discharges of such circuits may be compared to the action of a hydraulic ram, in which the stored energy of a long column of water is made to produce an abnormal discharge of water at one point.

Dr. Steinmetz then discussed the recent developments in lightning arresters of the types which oppose a counter e. m. f. to the line voltage. With a counter e. m. f. equal to that of the line, it is evident that the current passing to the ground by a lightning discharge is equal to that produced by the excess of the discharge voltage over the line voltage. A storage battery would be one means of providing such a counter e. m. f., but would be impracticable. An electrolytic cell, in which aluminum is the positive terminal, allows no current to pass except that caused by a voltage over and above the regular line voltage, while voltages in excess of the line voltage will cause a discharge through the cell. For alternating current, both electrodes or plates of the cell are of aluminum. Aluminum cells have the peculiarity that they have no definite polarization voltage. The counter e. m. f. which it opposes to the line builds up until it is equal to the line voltage. In the aluminum cell, only a small continuous current can exist, since the cell has a resistance as far as the line current is concerned of about 30,000 ohms per square inch of plate surface. A spark-gap can be placed in series with the cell, but since the cell must then stand on open circuit it gradually loses the film which opposes a counter e. m. f. to the line, and if left for several weeks becomes simply a water rheostat. The cell can be kept built up by connecting it in circuit and having current in it once a day or so. The aluminum cell, while opposing very high resistance to the line voltage, offers only 10 ohms per square inch of resistance to current caused to exist in it by abnormal voltages. He men-

tioned the experiments of Prof. Clayton in Colorado during the past summer, obtaining oscillograms on lightning discharges on a long unloaded transmission line. These showed that discharges follow each other rapidly. The frequencies of discharges were found to be of from one hundred to millions of cycles per second.

More Industrial Training for Massachusetts.

The Massachusetts Commission on Industrial Education has lately held several conferences with the heads of the Massachusetts Institute of Technology, the Worcester Polytechnic Institute, the Lawrence Scientific School, Simmons College and Tufts College in reference to the establishment of a State College of Industrial Training. It is felt that there is a vacancy between the high schools and the professional engineering schools which ought to be filled by an institution capable of training men for positions as industrial foremen and superintendents. The high school training is inadequate for this work, and the training of the engineering school tends to equip men for the highest positions of an executive or advisory character, with general charge over large projects. The lower technical schools do not provide the training necessary for the foreman or superintendent.

Evening courses for persons already employed in trades are now being established in many parts of the state under the general supervision of the commission, notably in Cambridge and New Bedford. Classes in mathematics for men in the machine trade have been opened at Beverly, where the United Show Machinery Company has a large plant. Worcester and Lawrence are considering the establishment of industrial schools for boys, preparatory to entering the machine industry, and in the latter cities the textile workers and firemen have asked for an evening school to meet their needs in their own trades. Waltham has made an appropriation, also, for evening courses in mechanical training. Public hearings will probably be held at the State House in the early future, and in January the commission will report its findings to the Legislature.

Working a Follow-Up System.

Mr. H. H. Lewis has an interesting article in the *Circle* for December, on the "professional systematizer," from which the following is worth quotation: A fair example of the diversity of subjects handled by the professional systematizer is found in the work of a man who not long ago was called to "gear" up the organization of a certain Boston house. The systematizer in question spent the better part of two weeks sauntering through the various departments of the plant.

He asked questions freely and made copious notes in a little book carried in his coat pocket. He watched the men at their work, examined the different machines in the manufacturing department, carefully inspected the various account-books, and even made a trip with one of the collectors. Then he set to work.

Among other things, the systematizer found that the firm in question advertised extensively the articles sold in their retail department. This advertising resulted in a call for the advertised articles either by mail or in person. Nine-tenths were personal calls, and yet probably one-third of the personal calls did not result in sales. To the systematizer this one-third loss did not seem necessary, and he immediately suggested a practical follow-up system.

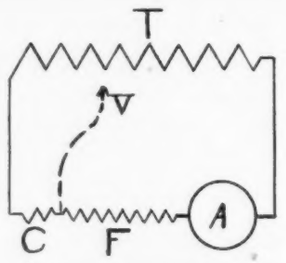
He had printed a form card containing a space for the name and address of the prospective customer, a line for the class of article in question, and a date line and place for remarks. The salesmen in the store were required to carry these blank forms and fill out one for each customer lost. The cards were then filed in a card-index, arranged by dates, so that in a few days or a week the card came to hand for attention.

If Mrs. Blank, for instance, should call to examine an advertised article and should not buy, the clerk attending her would get her name and address, and several days later a form-letter, a good imitation of a typewritten one, referring to the inquiry regarding certain goods and stating that a new stock has recently been added, would be received by her. This touch of personal attention seldom failed to bring good results. From the viewpoint of the professional systematizer, it meant at least the partial elimination of a one-third loss in sales.

Alternating-Current Railway Motors.

The section of the A. I. E. E. at the University of Illinois was favored on Nov. 27 with a lecture by Dr. C. P. Steinmetz on "Single-Phase Alternating-Current Railway Motors." Dr. Steinmetz first classified all motors under two heads—series and shunt motors. In shunt-wound direct-current motors the armature reaction which causes sparking at the commutator is taken care of by the shifting of the brushes if a motor always operates in one direction. If it must operate in two directions, the brushes have to be placed at the middle point between the poles. To prevent sparking in motors which must be reversed and must consequently have their brushes at a fixed position, the commutating-pole type of motor is being introduced.

Any direct-current series motor will run with alternating current if its magnetic structure is properly constructed to prevent heating from the alternating flux. To obtain a large power-factor, the number of turns in the armature should bear as high a ratio as possible to those in the field coils; the air-gap should be small. The sparking caused by the alternating field flux has been minimized by the use of resistance in the leads between the armature and the commutator segments. Dr.



CIRCUIT CONNECTIONS.

Steinmetz stated that the space is too limited in a railway motor for such leads with sufficient radiating area. While good results are being obtained with them, they are not desirable, and are a source of danger when the motor is overloaded.

He then took up the theory of the repulsion motor. In an alternating-current transformer the magnetic flux is 90 time-degrees behind the primary e. m. f. and 90 time-degrees ahead of the secondary e. m. f. In the repulsion motor the stator coils are connected to the alternating-current source of supply when the brushes are short-circuited. In such a motor the stator coils act as the primary and the rotor coils as the secondary of the transformer. In such a motor there are two magnetic fluxes in quadrature. The rotational flux in the rotor is displaced 90 time and space degrees from the main flux, and acts to assist good and sparkless commutation. When at a standstill, the repulsion motor acts exactly as a series motor, being no better and no worse. After it begins to rotate, the repulsion motor produces a commutating field. At synchronism the commutation is perfect; at speeds above synchronism, the commutation becomes worse, so that when revolving at double synchronism the plain repulsion motor sparks badly. He then described what he termed the series-repulsion motor, in which controller connections are employed which make it a repulsion motor at low speeds and a series motor with compensating field coils to improve commutation at high speeds. To illustrate the circuit connections at high speed he used the accompanying circuit diagram, in which *A* is the armature of a series motor, *F* the field coils and *C* the compensating coils for securing good commutation. *T* is the secondary of a transformer supplying energy to the motor. *V* is a variable connec-

tion, by which a larger or smaller proportion of the total voltage of the transformer can be impressed on the compensating field coils.

As to desirable frequencies for railway motors, Dr. Steinmetz said that motors of from 75 to 200 horse-power can be made to commutate in a satisfactory manner at speeds between 600 and 1600 r. p. m. on 25-cycle circuits. This answers the practical requirements. On 15-cycle circuits motors commutate well at speeds as low as 360 r. p. m. A 25-cycle installation would be superior in total economy for small motors. For very heavy locomotives the case possibly may be different, but he questioned whether a frequency of 25 cycles is not a low enough frequency for all purposes.

CURRENT NEWS AND NOTES.

ELECTRICAL FITTINGS.—The Underwriters' National Electric Association has just issued the October list of electrical fittings that have been examined and approved for use under the rules and requirements of the National Board of Underwriters.

ILLUMINATING ENGINEERS.—The next monthly meeting of the New York section of the Illuminating Engineering Society will be held in the United Engineering Societies' Building, on Dec. 12, when Mr. Bassett Jones, Jr., will read an illustrated paper on the "Relation of Architectural Principles to Illuminating Engineering Practice."

COLORADO SPRINGS ELECTRIC LIGHTING LITIGATION.—The history of the celebrated Colorado Springs electric lighting controversy is to be issued in book form, the text to be edited by Mr. Henry Floy, one of the board of arbitrators. The book will give verbatim the testimony of the large number of experts on lighting and illuminating questions who appeared before the board, and a summary of the legal arguments and citations in the case.

CHICAGO DRAINAGE CANAL POWER.—The new power plant on the Chicago Drainage Canal at Lockport, Ill., is now ready for service, the formal opening having been made Nov. 26. The transmission to Chicago is over a 44,000-volt aluminum line. The provisions made in the Chicago municipal electric lighting plants for utilizing this power have been already described in the ELECTRICAL WORLD. Besides supplying the city of Chicago, the West Park Board, the town of Cicero and the village of Morgan Park will purchase energy. About 16,000 horse-power has been so far developed.

THE NEW YORK SUBWAY.—Mr. Bion J. Arnold, as expert for the Public Service Commission, has filed a preliminary report as to improving conditions under which the crush is now developed morning and night, limiting speed and the number of trains. He advocates various changes in loading and starting, and favors side doors as a means of relieving the end doors. His report discusses in an admirable and most impartial manner the many difficulties of the problem—difficulties that in reality must await the construction of the other subways, before the crowds on the existing one can be lessened.

THE NOBEL PRIZE.—In accordance with cable dispatches noted recently, the State Department at Washington has been advised by the American minister at Stockholm, Mr. Graves, that Prof. A. A. Michelson, of Chicago, is to be awarded the Nobel prize for physics. Professor Michelson was born in Germany, but came to this country at an early age, and was appointed a midshipman at the Naval Academy. He was graduated in 1873, but resigned his commission in 1881, and is at present professor of physics at the University of Chicago. His work there as to the velocity of light, etc., has made him known throughout the world. The Nobel chemical prize is to be awarded to Sir William Crookes, the distinguished English physicist and inventor.

FEDERAL EMPLOYEES.—The U. S. Bureau of the Census has just sent to press the official register of federal employees. There are no fewer than 306,000. The total number of names included in Volume I is 125,805; the total number of names in the Postal Service in Volume II is 166,444, and in the Railway Mail Service is 13,892. The aggregate, therefore, of names presented in the Official Register for 1907 is thus 306,141. Volume I enumerates 1100 occupations followed by the servants of Uncle Sam. In the District of Columbia there are 28,947 government civil employees, with an aggregate compensation of $31,541,225.

LUMINOUS ARCS FOR CHICAGO.—The association formed to improve Dearborn Street, in Chicago, has voted to adopt the luminous arc lamp for the special lighting of that important down-town thoroughfare. Full details of the installation have not been worked out. If present plans are not changed, these luminous arc lamps will be placed about 25 ft. high on extensions of the street railway poles. Every other street railway pole will carry a lamp, the lamps being alternated. The diagonal distance from one lamp to another under this arrangement will average about 117 ft. As the luminous arc lamp throws so much of its light downward immediately around the pole, this spacing, if the ordinary globes were used, would result in areas between poles which would appear to be in darkness by comparison with the areas near the poles. The present plan is, therefore, to work out some scheme for spreading the downward light from the luminous arc so as to illuminate a larger street area.

A. S. M. E.—The American Society of Mechanical Engineers has been holding, this week, at the Engineering Societies' Building in New York City, its twenty-eighth annual meeting. President Hutton delivered an address on "The Mechanical Engineer and the Function of the Engineering Society" on Tuesday, and professional sessions were planned for the three following days, with a reception in the building, with dancing, etc., on Thursday evening. The visits and trips of inspection during the week include the Hudson Companies' tunnels under the North River, the Pennsylvania crosstown tunnel, the Watson-Stillman 300-hp gas producer and engine, and the new reinforced-concrete building of the McGraw Publishing Company, the home of the ELECTRICAL WORLD. On Tuesday night, new officers were elected as follows: M. L. Holman, of St. Louis, president; L. P. Breckenridge, of Urbana, Ill.; Fred J. Miller, and Arthur West, of Pittsburg, vice-presidents, and W. L. Abbott, Alexander C. Humphries and Henry G. Stott, managers.

CHICAGO ELECTRICAL SHOW.—At a recent meeting of the stockholders of the Electrical Trades Exposition, which conducts the Chicago electrical show in January, a large picture was exhibited showing the design of the decorative lighting of the Coliseum, which is to be the distinctive feature of the Chicago electrical show this year. This design has been worked out by D. H. Burnham & Company, the noted Chicago architects. The general scheme comprises a row of mammoth decorative chandeliers the length of the center line of the building and festoons of lamps hung from the arches. The booths will be of uniform design, this design being also made by the architects. The erection of booths and supply of furniture is in the hands of the exposition company, so that the exhibitor has only to move in his exhibit, thus saving a lot of trouble and annoyance to the exhibitor and producing a much better general effect. As a spectacular display, the coming show will undoubtedly offer the finest thing of the kind ever shown in the Coliseum. The dates of the show are Jan. 13 to 25, 1908. Mr. Homer E. Niesz, Monadnock Block, Chicago, is managing director.

THE DEBT OF BOSTON.—On the present showing, Boston is not likely to indulge in much municipal ownership. An official report has just been filed by a commission, showing the city debt to be $111,848,735 instead of $68,821,350 as reported by the city auditor. The commission states that there has been an increase in the net debt of the city of 111 per cent within the past 12 years, and it now amounts to 8½ per cent of the assessors' valuation of property subject to taxation, and to $183 per capita of the estimated population of the city for this year.

ALWAYS ON DUTY.—The Pittsburg Railways Company, operating all the local street car lines, has served notice on its employees that it will rigidly enforce the rule against the use of cigarettes or liquor while the men are either off or on duty. A number of men have recently been discharged, the company being able now, for the first time in years, to secure all the men it needs. J. J. Thorpe, business agent of the street car employees' union, called on President J. D. Callery, of the company, and protested against the discharge of the men, claiming that the company had no right to dictate to its employees when they were off duty. President Callery declared that he would stand by his order, and there is some strike talk among the employees.

DRIVING GERMAN LOOMS.—U. S. Consul George A. Bucklin, Jr., of Glauchau, reports that a master weaver of that German district has just put into successful operation his invention by means of which hand looms may be driven by electrical energy, a description of which follows: "It is so contrived that all of the parts of the old loom may be used except the 'frame.' The loom so made over answers all of the requirements of a power loom, and even works much more quietly, since the blow is given by a spring which is compressed by an eccentric. The power for such a loom is said to be inexpensive, the cost of the electricity consumed amounting to about 28 cents per week. The operation of the loom is so simple that it can be directed by a child. The invention is one that promises to be of great value to this region, as of late years there have been hundreds of looms crowded almost or entirely out of operation by the more rapid and labor-saving power loom. A preliminary patent has already been granted."

MOTOR vs. GAS-ENGINE POWER.—The *West Ham Electrical Bulletin*— an excellent quarterly publication issued by the municipal electric light plant of West Ham, England—prints in the current issue the following comparative statement of cost of electricity and gas, in the form of a communication from a customer who operates a dyeing and cleaning establishment:

	£	s.	d.
Gas bill for engine from June, 1905, to June, 1906.....	43	18	4
Oil for gas engine.....	4	16	0
Total	48	14	4
Bill for energy for electric motors, June, 1906, to June, 1907	24	7	11
Oil for motors.....	..	6	0
Total	24	13	11

If the cost of renewals, repairs, and wear and tear were considered, the showing would be still more in favor of the electric motor.

CITY TUNNEL OWNERSHIP.—It is stated that a plan has been advanced by those interested in seeing the Belmont tunnel between Manhattan and Long Island City opened to the public, and is now being seriously considered, which contemplates the acquisition of the property by the city and what would amount to a partnership in its operation between the city and the interests now owning the tunnel. It was learned yesterday that it is by no means improbable that the plan will come before the Public Service Commission within a short time. The plan is that the city shall buy the tunnel, as it stands, for what it cost to construct it, with interest to date; shall pay for it with city bonds instead of cash, and shall enter into a contract with the Belmont interests whereby those interests shall operate the line in connection with the Queens County surface lines, the net earnings to be equally divided between the city and the Belmont people, and the city to apply its share of the proceeds to the payment of the interest on the bonds.

AMERICAN MANUFACTURES.—Fifteen billions of dollars represent the value of the production of manufactures in the United States in the year ended June 30, as shown in the annual report of Col. John M. Carson, Chief of the Bureau of Manufactures. Last year the aggregate value of domestic merchandise exported was $1,854,000,000, an increase of nearly $136,000,000 over the preceding year. In this classification "manufactures ready for consumption" are credited with $480,000,000, and "food-stuffs partly or wholly manufactured" and "manufactures for further use in manufacturing," aggregating $606,000,000, are grouped, making the aggregate value of manufactures exported $1,086,000,000. Special significance is attached to the increase of nearly $20,000,000 in the exports of completed manufactures, in view of the fact that the exports of cotton cloths declined more than $21,000,000 because of the loss in the cotton trade with China. The success attending investigation by experts sent abroad has led to the adoption of the policy of specializing investigations of trade conditions in foreign markets. One of the obstacles to the enlargement of export trade is the uncertainty of transit between places of production and the seaboard. Merchants in the Orient especially complain that calculation cannot be made as to when goods ordered in the United States will be delivered, and in consequence orders go to European houses that should come to those of this country. The bureau has been in correspondence with managers of railway and ocean steamship companies with a view to obtaining more reliable and rapid transit for merchandise destined to foreign countries.

POWER FOR JAPAN.—Extensive plans are proposed for electrical development in Japan. In a preliminary report on the subject, Julius M. Howells states that the outlook for cheap water power in Japan is very favorable. In the case of one power site on the Tashiragawa the construction of a tunnel 3½ miles long would, it is stated, secure about 66,000 horsepower, and at another power site by means of some 10 miles of tunnel and a certain amount of open canal construction 150,000 horse-power could, it is reported, be secured. In the first instance there is a good reservoir site for purposes of storage, while in the second instance advantage would be taken of natural lakes. These sites, and others which have been surveyed, are in the Fujiyama district. Additional sources of power are near Nikko, where Lake Chuenji would form the storage reservoir, and where, with 4 miles of tunneling, a fall of 2000 ft. could be secured; also in the Lake Inawashiro district, where the construction of 4 miles of tunneling would provide upwards of 50,000 horse-power. An inspection of the principal sites and a study of the rainfall statistics over many years point to the probability of the initial plants giving, even during periods of drought, 300,000 horse-power. A favorable feature of the scheme is that the power sites provisionally selected are located within a comparatively short distance of Tokio, where at the outset the bulk of the power would be taken. Between the capital and the sites referred to, there is a minimum transmission distance of 80 miles and a maximum of 150 miles. It is estimated that the present requirements of Tokio represent 48,000 horse-power, and that plants which will call for an additional 20,000 horse-power are in process of erection. These figures do not, however, include the electric road from Tokio to Yokohama, or the elevated road which is being constructed by the government in Tokio. One of the chief power sites is within 135 miles of the old capital, Kioto, and Osaka, the Manchester of Japan, is only 160 miles distant.

Electric Generating Equipment of the New Orleans Railway & Light Co.

THE work of eliminating smaller and less economical generating stations, and centralizing the production of energy in large stations, having been completed by the New Orleans Railway & Light Company, it is believed that a description of the changes introduced will prove of interest.

The plan of concentrating all equipment in a single station was not adopted, for the reason that it would have necessitated the abandonment of two modern generating stations, and because in some areas the distribution of the railway load made it more economical to generate direct current near the points of heavy consumption rather than to produce alternating current in one central station with high-tension transmission and conversion to direct current in sub-stations located at the points of consumption. The lesser likelihood of complete shutdowns in cases of station troubles was another consideration.

The system as reconstructed comprises one direct-current commercial lighting station and one direct-current railway station in the congested districts, and one large alternating-current station to feed the balance of the territory and the outlying districts. This station also contains 6000 kilowatts of direct-current generators for feeding the railway lines in its vicinity. The three stations have an aggregate rating of 25,000 kilowatts. As the load increases and the system is extended additional sub-stations are to be built and the equipment of the main or alternating-current power station is to be increased up to 50,000 kilowatts. It is not necessary that new generating stations be built until the output indicated is reached.

A frequency of 60 cycles has been adopted as standard for all generators. The decision against 25 cycles was based upon the much greater cost of such installation, which would have involved heavy expense for frequency-changing apparatus for the large amount of the service requiring 60 cycles, and the unsuitability of 25 cycles for the operation of incandescent and arc lamps. By using only one frequency the load factor on the station and on the generating units was much improved, with resulting large savings in the cost of generated energy, and the idle investment in reserve apparatus was minimized. The large sub-station energy loss which would have resulted from the use of such frequency changers as would have been necessary had 25-cycle generation been adopted was saved by the adoption of a uniform 60-cycle frequency

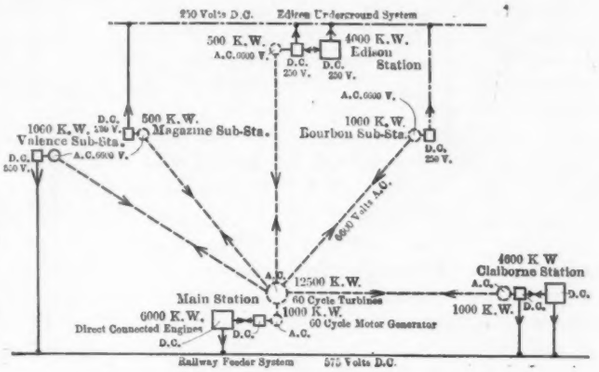


FIG. 1.—ELECTRICAL CONNECTIONS OF STEAM STATIONS AND GENERATING SUB-STATIONS.

FIG. 2.—INTERIOR VIEW OF CENTRAL GENERATING STATION.

It is believed that the higher frequency standard more nearly satisfies all of the present and future requirements and that it will show a decidedly higher all-around efficiency, everything considered, than 25 cycles or a combination of 25-cycle and 60-cycle generation. Furthermore, increase in business is

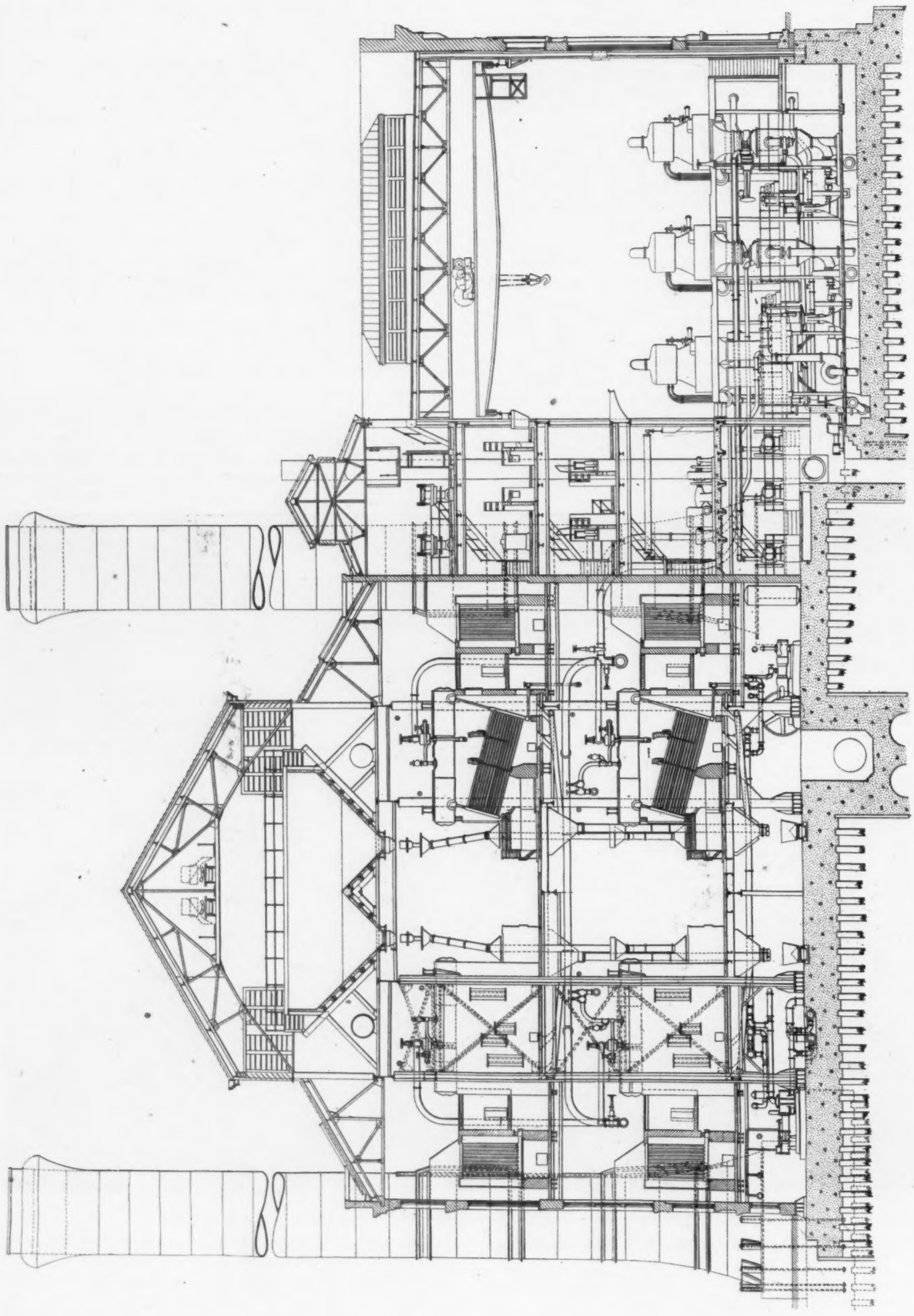


FIG. 3.—CROSS-SECTION ELEVATION OF MAIN POWER HOUSE OF THE NEW ORLEANS RAILWAY & LIGHTING COMPANY.

largely dependent upon adopting a system which will involve the least first cost of installation to the consumer. The lesser cost of 60-cycle motors constitutes an important factor viewed from the standpoint of the operating company.

A voltage of 6600 was adopted as being a thoroughly stand-

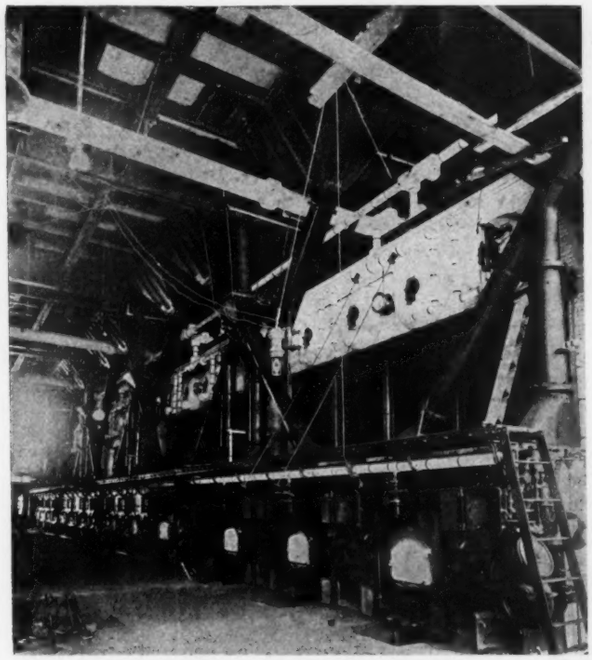


FIG. 4.—BOILER ROOM OF MAIN STATION.

ardized commercial voltage, for which motor generator sets of 500 kw and upwards could be readily wound, thus eliminating sub-station transformers. The transmission distances, being relatively short, did not call for a voltage higher than 6600, which would permit sending the maximum desired amount of power through any individual feeder with small loss. The frequent flooding of the underground conduits by heavy rains, which, for short periods, may overtax the drainage system, ren-

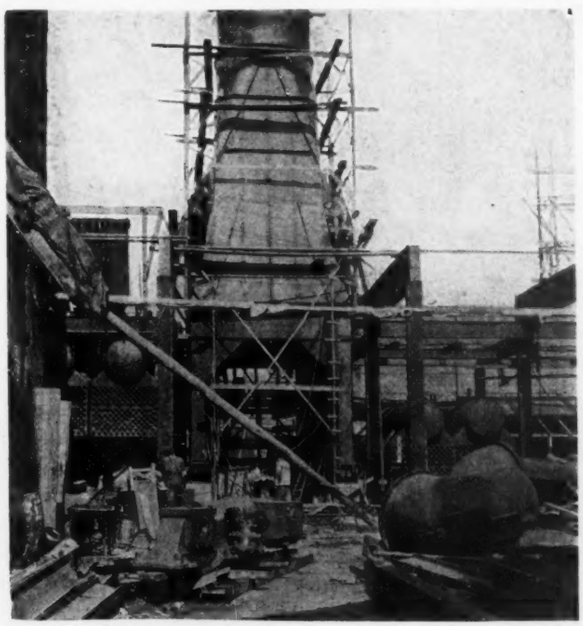


FIG. 5.—STEEL WORK OF STACK AT CLAIBORNE STATION.

dered expedient the adoption of a moderate voltage, involving no particular difficulties for insulation under these conditions.

The recent work has involved the construction of practically an entirely new station at Market and South Peters Streets, on the Mississippi River, about two miles upstream from the business center of the city. The station now contains 17,800 kilowatts and will have an ultimate output of 50,000 kilowatts.

THE MAIN STATION.

The new station building is a brick, steel and concrete structure, 122 ft. in height, with a ground area of 181 ft. by 212 ft. It is supported on approximately 4000 round piles driven on about 3-ft. centers. The piles are 50 ft. long and some were set 30 ft. below the surface or were driven to a total penetration of 80 ft. The average load over the entire foundation is somewhat less than 2000 lbs. per sq. ft., but at points the load is concentrated and is very much more. At such points twisted steel rods were used to reinforce the concrete mat.

TURBO-GENERATORS.

In the new portion of the generator room there are installed three 1500-kw, three-phase, 60-cycle, 2300-volt Curtis turbo-generators. A 3000-kw and a 500-kw, 6600-volt turbo-generators of the same make are also provided in the initial building, the former now being in operation and the latter under construction.

One common oiling system with one accumulator supplies oil to the step bearings of the three smaller turbines. A sep-

FIG. 6.—BASEMENT OF HOWARD AVENUE TERMINAL HOUSE.

arate oiling system with an accumulator is provided for the two larger turbines. The oil pumps and other auxiliary apparatus except the exciters are located in the basement.

MOTOR-GENERATORS.

Three motor-generator sets now operating on other service, each consisting of a 500-kw, 2300-volt synchronous motor and a 600-volt direct-current generator, are to be installed on the main floor alongside the exciters under the bus structures and will permit transferring 1500 kilowatts from either the alternating-current or the direct-current portion of the station.

EXCITERS.

The equipment already installed consists of an 80-kw induction motor-driven exciter and a 75-kw exciter driven by a two-stage horizontal Curtis turbine. The exciters are connected to a double bus system, and voltage regulation is effected by a Tirrill regulator built for four exciters. Plans provide for two additional 150-kw exciter sets which will be installed near those already in operation on the main floor.

SWITCHBOARD AND CONTROL APPARATUS.

The switchboard proper is located on an overhanging balcony at the same height as the second floor of that section of the building between the boiler and generator room. From his position on the balcony the operator has a general view of the entire operating floor. Behind the switchboard are the generator switch and bus structures. On the floor above are similar structures for feeder busses and switches and there is also located on the floor 2300-volt regulators for the commercial feeder circuits. On the fourth or top floor is an arc lamp sub-station. All main and high-tension switches are of the oil-break type controlled from the main switchboard by pilot

switches. Both the generator and the feeder bus-bars are in duplicate, and all may be sectionalized.

The bus and cell structures are built in groups with the main and auxiliary bus structures flanking a common passageway on the second floor and the feeder bus structures similarly arranged on the third floor. The structures are of concrete with the exception that the tops and bottoms of the generator and sectionalizing switch compartments are of Alberene stone. The structures are reinforced by iron rods running through the barriers from top to bottom. The generator leads are carried down under the generator room floor from the generator terminals to junction boxes and then up the building columns in brass conduit direct to the generator switches of the main generator and auxiliary busses. A group switch connects the 2300-volt main generator bus to a main feeder bus on the floor above and a similar switch connects the generator auxiliary bus with an emergency feeder bus. The 6600-volt generator and auxiliary busses are permanently connected to extensions of these busses in structures on the floor above and from which the feeders are taken off. The 6600-volt and the 2300-volt bus systems are connected by two 1500-kw oil-insulated, water-cooled, three-phase transformers, located in the basement.

CONTROL PANELS.

The generator control panels are located at the west end of the initial switchboard, the plans providing for the installation of 6600-volt feeder panels west thereof, so that they will be centrally located with respect to the ultimate switchboard. To the east of the generator panels are exciter and house service panels and space for three synchronous motor and three railway generator panels.

FEEDERS.

The construction permits feeders leaving the station in underground conduits. They now leave overhead connecting with pole lines, those for the down-town district continuing overhead to a terminal house located about a mile distant from the station at the edge of the underground district.

From the feeder busses the arc lamp lines pass to the constant-current alternating-current arc regulators on the top floor, there being provision for 22 feeders in the sub-station. The 2300-volt feeders for the commercial lighting load pass through oil-insulated, water-cooled regulators.

THE BOILER HOUSE.

The present building provides for sixteen 900-hp boilers. Twelve such units of the Babcock & Wilcox water-tube type are now installed. They are located on two decks in double rows facing each other and parallel to the generator room wall. They are constructed for 200 lbs. pressure and are fitted with bent tube superheaters designed for 150 deg. superheat. Behind them are Sturtevant economizers, there being one economizer with 4900 sq. ft. of heating surface to each two boilers. The scrapers of the economizers are driven by induction motors. The boiler plant is equipped with thirty-six 300-hp Murphy smokeless furnaces and stokers, set three in a battery under each boiler. Coal is fed to the furnaces through down spouts extending from the overhead bunkers. Ashes from the furnaces fall direct into a hopper underneath, while the fine ashes drawn over the bridge wall and the soot accumulation are carried into such hopper by a motor-driven screw conveyor.

FEED WATER.

Boiler feed water is obtained from two 750-ft. wells, one 6 and 8 ins. in diameter, having a combined output of over 1800 gals. per minute. Water is raised with air furnished by two Ingersoll-Sergeant air compressors installed in a compressor room in the boiler room basement. The water is discharged either into tanks in the basement of the boiler room or into a stand pipe holding 60,000 gals. located near the building. The boilers are fed by a steam turbine-driven centrifugal pump and three Epping Carpenter pumps. These pumps are of the pot valve type with outside end packed plungers and are fitted with automatic pressure regulating governors. Connections are arranged so that the water may be forced either through the economizers or direct into the boilers.

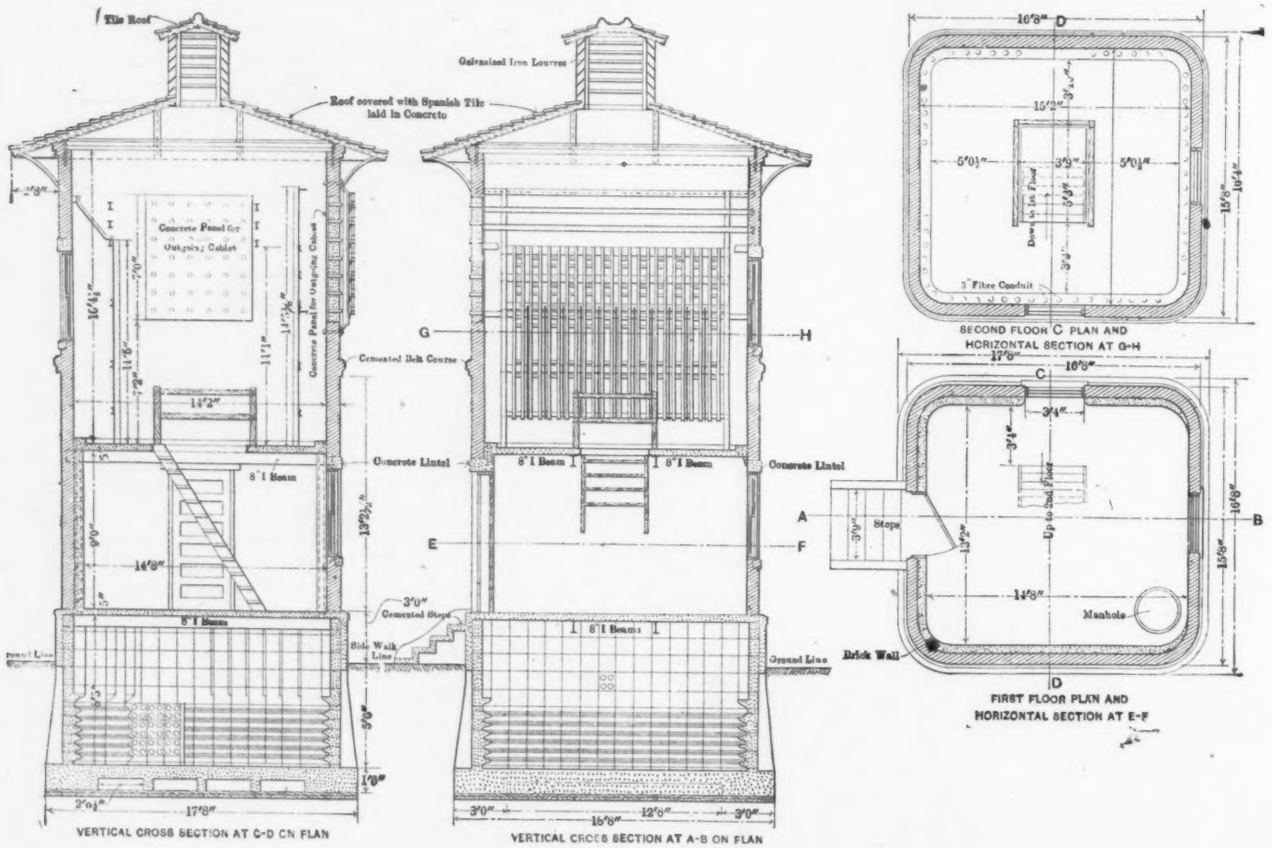


FIG 7.—PLANS AND SECTIONS OF HOWARD AVENUE TERMINAL HOUSE.

COAL-HANDLING APPARATUS.

A switch extending along the east end of the station contains a 100-ton track scale and all cars are weighed before and after being unloaded. The cars are run on a sheltered track under the ash bunker at the end of the boiler house and unloaded into a hopper beneath the track. After passing through a crusher provided with an adjustable positive feed the coal is carried by a bucket elevator to the top of the boiler house structure, where it is discharged on a belt conveyor and distributed to any predetermined part of the coal bunkers by an automatic unloader. A 35-hp, 550-volt, direct-current motor drives the crusher and both the belt and the bucket conveyors.

The initial coal-handling plant can handle 100 tons per hour and the plans provide for a duplicate equipment of equal rating. The initial coal bunkers hold 2000 tons and those of the ultimate building will store about 5000 tons. Additional storage space is provided in a vacant lot near the station, coal being conveyed to and from this space in electric cars. Dock privileges have been obtained from the city and a portion of the plant for unloading river coal from boats has been erected. This has been designed to handle 200 tons per hour.

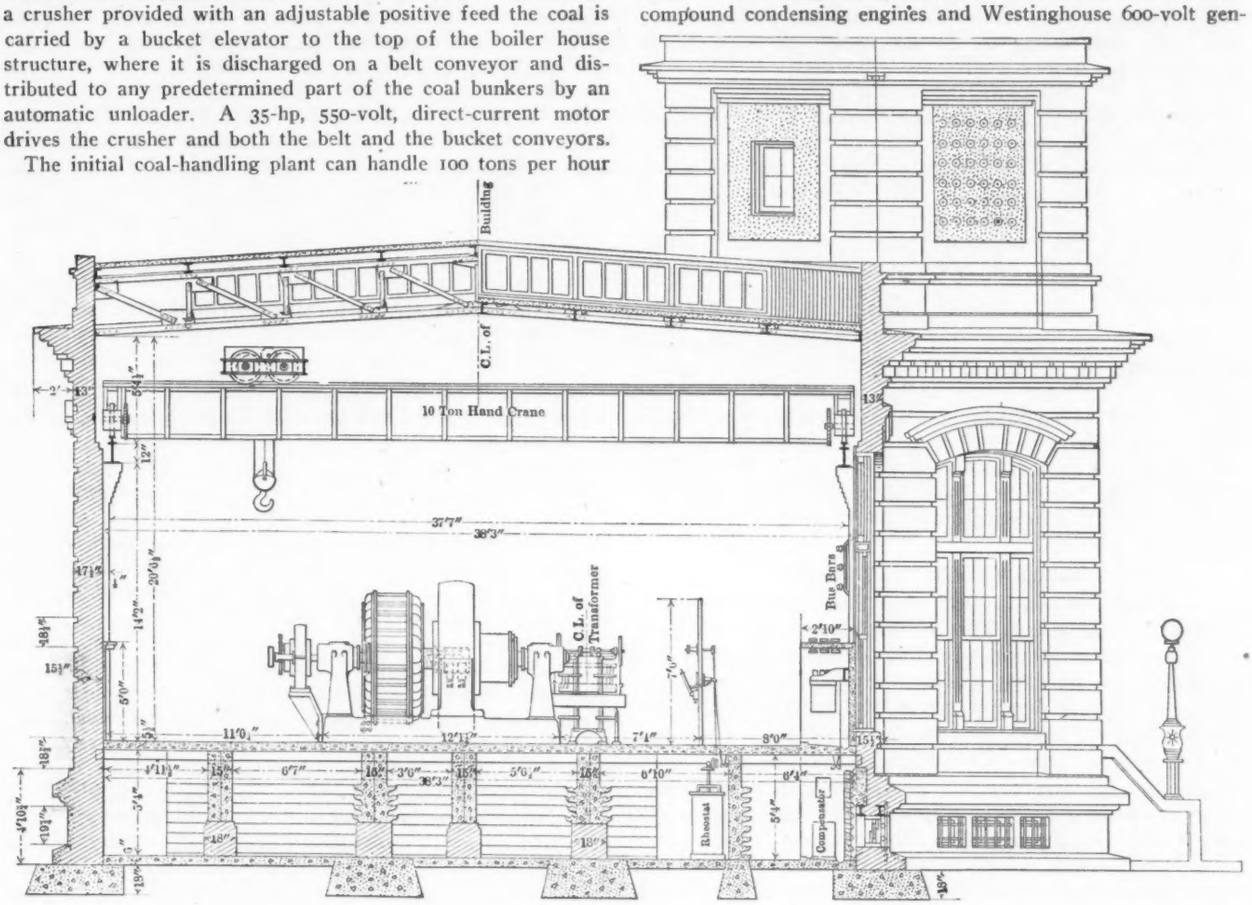


FIG. 8.—ARRANGEMENT OF APPARATUS AT THE VALENCE SUB-STATION.

ASH-HANDLING PLANT.

Small side-dump cars operating on tracks in the basement underneath the ash hoppers convey the contents of these hoppers to the east end of the building where the ashes are dumped into an automatic skip. This skip bucket, holding 60 cu. ft., hoists the ashes to the top of the boiler room and dumps them into a bunker built over the coal switch. Ashes are discharged by gravity from the bunker direct into steam or electric cars and conveyed to the suburbs to be used in track construction or filling.

THE CLAIBORNE STATION.

The Claiborne station is located at Elysian Fields Street and the river, about two miles below the Main or Market Street station. It is essentially a direct-current station. The original portion, built about nine years ago, contains two 300-kw and one 850-kw General Electric railway generators direct connected to Allis-Chalmers compound engines, and four 350-hp Edgemoor boilers. A new station has been built in line with the original station, the old plant reconstructed and 3200 kilowatts of engine-driven, direct-current railway units, 1000 kilowatts of railway motor-generator sets, with the requisite switchboard and steam generating plant, have been newly installed.

ELECTRICAL MACHINERY.

The two 1200-kw generating units installed in the new portion of the building consist of Filer & Stowell horizontal cross-compound condensing engines and Westinghouse 600-volt generators. The 800-kw unit is an Allis-Chalmers cross-compound engine with a General Electric 600-volt generator. Plans provide for the installation of an additional 800-kw unit. The station is tied electrically to the other stations of the system through two 500-kw motor-generator sets consisting of 6600-volt synchronous motors and 600-volt direct-current generators.

THE BOILER ROOM.

The boilers are installed in one row parallel to the engine room wall. For ventilation the wall opposite the furnaces is open to a point 9 ft. above the floor. Each of the four 600-hp Heine boilers is equipped with two 6-ft. by 8-ft. Murphy smokeless furnaces and stokers of a design similar to those in the main station. The concrete bunkers located above the open space in front of the boilers hold 100 tons per boiler. Over the rear of the boilers in the new section are installed four Sturtevant economizers. They are so set and piped that a boiler and an economizer constitute a single unit, but the flue connections are such that any one economizer may be cut out without interfering with the use of the corresponding boiler. When one is cut out the water for all of the boilers may be passed through those economizers remaining in service. The economizers are cut out by means of an interlocking mechanism operated by a lever from the boiler room floor. The coal-handling equipment is similar to that at the main station.

THE STACK.

The method adopted for supporting the one steel stack which extends through the central portion of the room gave

considerable additional floor space in the boiler room. The stack is supported on four steel columns, which extend from the boiler room floor to the base of the stack at about the height of the top of the boilers. The columns are stiffened with concrete, and those portions in the engine room are arched over with brick. The stack is of steel 11 ft. in diameter and 175 ft. high. The base is square and is constructed without a base ring. The side sheets are riveted directly between channel framing at the base.

BARONNE STREET STATION.

Practically the only important changes made in the old direct-current station, known as the Baronne Street station, has been to equip the boilers with Murphy furnaces and mechanical stokers. In order to provide sufficient stoker equipment it was found necessary to install three stokers under each battery of two boilers, and this required that a portion of the center wall between the boilers be specially supported from the boiler room girders.

VALENCE SUB-STATION.

This is the first recently constructed permanent sub-station, and the only one yet finished outside of those in the power stations. It is located in the western portion of the city, at Valence and Franklin Streets, and about three miles northwest of the Market Street station. It is a combination arc lighting and railway sub-station, and at present contains six 110-lamp constant-current transformers and two 500-kw motor-generator sets. Provision is also made for its future use as a commercial lighting sub-station.

MAGAZINE STREET SUB-STATION.

A temporary sub-station for commercial lighting has been installed in an existing building on Magazine Street, near Poydras. This sub-station contains a 500-kw motor-generator set, consisting of a 6600-volt synchronous motor and a 250-volt generator, which feeds across the outside wires of the direct-current, three-wire system covering the downtown district.

BOURBON SUB-STATION.

There is now being installed in this sub-station a 1000-kw synchronous motor generator set, 6600 volts alternating to 250 volts direct, for supplying energy to a section of the underground system. The present sub-station building is temporary, but the foundations and sub-grade work is of permanent character, and will constitute a part of the ultimate sub-station construction aggregating some 5000 kilowatts capacity.

DRYADES SUB-STATION.

This sub-station is an installation containing constant-current transformers having an aggregate rating for 600 arc lamps and one 500-kw motor-generator set which operates in conjunction with the steam-driven generator in the Baronne Street station.

CONDUIT SYSTEM.

In the downtown district the high-tension connections between all the power stations and sub-stations are underground. The recent work has included the construction of about 600,000 duct-feet of conduit, and approximately 150 manholes. This was necessitated by the extension of the underground district to about double its former area.

The ducts are of 3-in. fiber conduit laid with 1 in. of gravel concrete between ducts, and with approximately 4 ins. on all sides. The larger portion of the system was constructed of four duct runs and ranged up to thirty-six ducts.

The manholes are usually located at street corners, but additional ones were occasionally built in the middle of long blocks. The manholes are made largely of molded concrete blocks, which, in addition to forming walls, carry projections which serve as shelves for the cables, and act as barriers between adjacent cables.

THE TERMINAL HOUSE.

The overhead lines from the main generating station, extending into the underground district, are carried into a terminal house about one mile from such station. This is a two-story and basement fireproof brick and concrete structure 15 ft. 8 ins. square. The overhead lines enter the upper room, on the walls of which disconnecting knife switches are installed on frames with slate barriers between them..

The above described improvements in New Orleans have been designed and executed by the engineering and construction organization of Sanderson & Porter, New York. Their New Orleans office—W. A. Haller, resident engineer—has substantially completed all the work herein described and the installation of the initial equipment, in such manner as will readily permit of enlargements from time to time, as required by the growth of the city.

The work has benefited greatly by the cordial co-operation which has existed between the representatives of the constructors and the officials of the New Orleans Railway & Light Company, the latter, particularly, including E. C. Foster, president; J. H. DeGrange, vice-president; A. L. Black, engineer, and E. B. McKinney, superintendent of power.

Characteristics of the Magnetite Arc.

By G. M. Dyott.

On account of the great interest that is being taken at the present time in the development of the flaming arc lamp, and in illumination in general, the result of some investigations conducted by the writer with metallic arcs might be of interest to those who are making a study of the more recent methods of lighting. From time to time articles have been published concerning the magnetite arc, but they have dealt more with the lamp in general and its commercial aspect rather than with the peculiarities of the arc itself and the effect upon its behavior of certain substances incorporated in the electrodes.

The magnetite arc presents many very attractive features which especially recommend its use for series street lighting. The light has great carrying capacity, the distribution is good, the maximum being between 20 deg. and the horizontal, while the total light emitted by a 300-watt arc is approximately twice as great as that from an alternating-current series enclosed carbon lamp consuming 450 watts. The life of the electrodes also compares very favorably with that of the latter, 200 hours or more being allowed between trimmings. The magnetite arc differs from the carbon arc in practically every respect. It can only be maintained on a direct-current circuit and should be used in conjunction with a metallic positive in order to secure the best results. Should a magnetite be used for the positive as well as the negative electrode the arc loses some of its brilliancy, and its efficiency is thereby impaired; moreover, the positive electrode, which when metallic lasts 2000 hours or more, is consumed fairly rapidly. On alternating-current circuits it is impossible to maintain an arc, unless a specially prepared electrode is used.

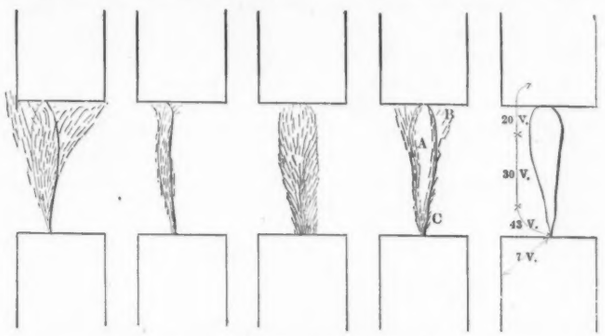
The magnetite electrode must in all cases form the negative, and is, as a rule, placed in the lower holder of the lamp. It is the more important of the two, as the character of the arc is dependent on its composition. The size of the positive has little effect on the behavior of the arc, so that while studying its characteristics it will be assumed to be made of a heavy copper rod 1 in. in diameter.

It has been found that a very satisfactory negative electrode for experimental purposes can be made out of the following materials: magnetic iron ore, Fe_3O_4, chrome iron ore, $FeCr_2O_4$, titanium oxide, TiO_2. For commercial work it is necessary to add other substances such as arc-steadying compounds. The bulk of the electrodes consists of magnetite, the percentage used varying over a wide range like the other ingredients, according to the conditions under which the final mixture must subsequently be used. Its most important function is to act as a carrier in the arc. The slag formed by it is a conductor when cold, and hence difficulties encountered in starting the arc are eliminated. Its high luminous efficiency also makes it a very desirable substance to use. Ordinary magnetite is much too impure to prove satisfactory, and special arrangements should be made to obtain it free from all silica, lime, magnesia, etc. An arc maintained between electrodes of pure magnetite

is very rich in blue and ultra-violet rays. It issues from the negative at a point and spreads out like a fan toward the positive although the anode spot itself is small. The central cone is slightly more luminous than the outer sheath, as is shown in Fig. 1. The arc itself is unstable and emits copious fumes.

In order to neutralize the excessive blue rays emitted by the iron arc alone, and at the same time to increase its efficiency, titanium oxide is added in varying proportions according to the percentage of the other materials forming the electrode. The arc produced between electrodes of this oxide alone is very brilliant; it is pure white in color, gives off fumes and forms an insulating slag when cold; it is also very unstable and assumes a shape such as shown in Fig. 2. If only magnetite and titanium oxide were used the unstability of the arc would be so great as to render it unsuitable for any practical application, so in order to overcome this defect and at the same time increase the life of the electrodes either oxide of chromium or chrome iron ore, called chromite, is added, the latter being perhaps the better of the two.

The arc of the oxide of chromium is of a dull greenish-yellow color and burns steadily, but its luminous efficiency is low. It forms an insulating slag when cold, consumes very slowly and gives off hardly any fumes. It is not pointed at its lower



FIGS. 1 TO 5.—MAGNETITE ARC.

extremity, but assumes the shape shown in Fig. 3. The shape and general character of the composite arc can be judged by reference to Fig. 4. It will be seen that the center is composed of a narrow band *A*, its brilliancy and thickness being dependent on the amount of TiO_2 present; the greater this percentage the narrower this band becomes. When TiO_2 is absent the central cone can hardly be perceived. The outer sheath *B* is composed of fumes and gives but little light; it is more important the higher the percentages of magnetite used. The lower portion of the cone *C* is characteristic of the quantity of chromium present. Should the point be very sharp and unstable, this quantity is low, but as it is raised the sharpness becomes less and less apparent. On further increasing the percentage, the arc becomes more and more steady and ceases to wander about the surface of the electrode; in an extreme case it becomes greenish-yellow, and loses all of its clearly defined outline. If impurities are present in any quantity they will be indicated by the behavior of this point.

As previously stated the arc appears to issue from the surface of the negative as a high-velocity blast impinging on the copper positive, and since the majority of the light is emitted at the negative end of the vapor bridge a reflector should be used in order to secure the best results.

From this it is evident that considerable gain in efficiency can be secured by burning the arc reversed; that is to say, with the negative in the upper holder of the lamp. Heretofore this arrangement has been beset with so many mechanical difficulties that it has received very little consideration despite its many attractive features, but in a lamp recently put on the market this type of construction has been used with remarkable results.

The voltage drop across a 1-in. magnetite arc consuming 5 amperes at 100 volts is shown in Fig. 5. It will be observed that the greatest drop occurs from the metal sheath of the negative to about ¼ in. away from the lower tip of arc.

Should the direction of the current be reversed, the whole character of the arc is changed; it loses all of its striking brilliancy and becomes a flaming arc in the true sense of the word, having a dull yellowish color.

While the characteristics of the arc are dependent on the negative electrode, it is around the positive that most of the difficulties center. They may be briefly stated as follows: (1) After continuous service fumes are deposited on the positive electrode, which adhere to it and hang down over the arc, sometimes entirely cutting off the light; (2) materials used for the positive are liable to oxidize owing to the heat of arc and form oxides which are insulators when cold; the arc is thereby prevented from starting; (3) globules of molten matter are taken up by the positive from the negative, which affects somewhat the burning of the arc.

As far as the result of experiment goes the choice of material for the positive seems to be limited to copper, iron, alloys or mechanical combinations of these metals. Copper scales off under great heat and its surface has a very rough appearance, due to the copper oxide scales which cause the scales to adhere to it. Iron by itself consumes too rapidly. Brass appears to be very satisfactory; it always has a clean, smooth surface, and any globules that may adhere to it at its lower extremity crack off and fall into the pan below when the light is extinguished. Further experiments, however, might disclose objections to its use. Attempts have been made to use laminated electrodes, consisting of metals and alloys in successive layers, with encouraging results. Of course, the expense of making such electrodes might prevent their commercial use.

The Infringement of Patents.

BY JOHN EDSON BRADY.

When a patent is issued, three exclusive rights are secured by it to the patentee, namely, the right to make the patented article, process or whatever it may be; the right to use it, and the right to sell or lease it to others. Broadly speaking, it is an infringement to invade any one of these three rights. A patent for a process is infringed by him who, without ownership or license, uses substantially the process which the patent claims, whether or not he uses substantially the apparatus which the patent describes, and whether he uses the materials prescribed by the patent, or uses equivalents therefor. Infringement of a process patent may occur even where precise identity does not exist between the process claimed by the patent and that used by the infringer.

The patent in the case of Mowry vs. Whitney, 14 Wallace 620 (1871), covered a process which consists in taking cast-iron car wheels from their molds as soon as they become solid enough to retain their shape, and in immediately placing the wheels in a furnace or chamber, previously heated to about the temperature of the wheels when taken from the molds, reheating the wheels therein, and then in finally causing them to cool with a great degree of slowness. The infringer's process consisted in taking the wheels red hot from the molds, putting them in an unheated chamber, interlaying them with charcoal, covering the whole with a perforated metal plate, then causing the charcoal to burn so as to reheat the wheels to an indefinitely high temperature, and so adjusting the draft as to make the charcoal burn out, and the wheels, consequently, to cool down with a great degree of slowness. The Supreme Court of the United States found that all of the steps of the complainant's process were included in the defendant's method, though confessedly the reheating was done by different means and the slow cooling regulated on different principles from those which controlled the corresponding parts of the complainant's process.

The fact that the infringer did not know of the existence of the infringed patent has sometimes been relied upon as a defense to an action brought by the patentee. The general rule is that the motive or intent with which the act of infringement is committed is material and that a person may invade the rights of a patentee without intending, or even without being

aware of the existence of the patent; but he is none the less an infringer. Parker vs. Hulme, 1 Fish. Pat. Cases, 44. A person may act in the best of faith and under the protection of supposedly valid patents, but if he thereby infringes a prior patent, his ignorance or good faith will not avail him as a defense. The owner of the prior patent is entitled to restrain the infringement and to collect damages, and his right to do so does not depend upon the infringer's ignorance or knowledge. Timkin vs. Olin, 41 Fed. Rep. 169. One sufficient reason why ignorance of the existence of a patent is no excuse to the infringer, against whom suit is brought, is that a patent is a public record, of which all persons are bound to take notice. Bate Refrigerating Company vs. Gillett, 31 Fed. Rep. 809. However, the fact that one who is charged as an infringer has secured a patent upon the alleged infringing device is always entitled to weight in determining whether or not there has been an infringement. For the issue of a patent follows the decision of official experts specially appointed and qualified to examine and pass upon the claimed invention for which the patent is sought. And by the act of granting the patent they express their opinion that it does not conflict or interfere with patents previously granted. Of course, a valid patent is not to be overthrown by the issue of a subsequent patent to another person for the same thing; but when the question of infringement is at issue, and expert testimony is necessary, the action of the official experts on the subject calls for consideration, especially where doubt exists.

Obviously, there can be no great variety of fact in those defenses to an action for infringement which are based upon lack of knowledge on the part of the infringer. The unfortunate invader of the rights of the patentee can simply say that he knew nothing of the patent and that he acted unwittingly. In Thompson vs. Busnell Company, 96 Fed. Rep. 238, an action to restrain the infringement of a patent covering a saw intended for cutting metal and other hard substances, the defense was that the saws were "accidentally made and unintentionally sold by the defendant." But it was held that the patentee was entitled to protection against accidental infringemens and against the possible repetition of such accidents. The defendant in this instance advanced another equally weak defense, which was to the effect that the patented saw was impracticable and defective. Upon this point the judge, before whom the trial was had, made the following observation: "If, as they now contend, the saw of the patent in suit is impracticable and the defectiveness which results from the invention of the patent in suit is a disadvantage, the defendant will not suffer from the effect of an injunction which will operate to prevent its making such defective saws in the future, accidentally or otherwise."

The use of a thing not claimed by the patentee does not constitute an infringement. When the language of the specification, which defines the patented article, shows exactly what the patentee desires to secure as a monopoly, nothing that does not fall within the terms, which the patentee has thus chosen to express his invention, can be held to be an infringement. But a slight or immaterial change made for the purpose of avoiding the exact wording of the claim will not avail to avoid infringement. And, on the other hand, if the alleged infringement differs in principle from the patented device, it is not an infringement, although it may be within the letter of the claim of the patent. In every patent the language of the claim, specification and grant should be so clear, distinct and positive as to leave no question as to what was asked and granted, nor should it require a careful and labored investigation to ascertain whether one may not have trespassed upon the rights of the patentee. It is the duty of an inventor to use language sufficiently plain and explicit in his application for a patent to denote clearly what he asks for; and where he fails to do so, and the language of the grant of letters patent follows that of the application, and is thereby misleading to the general public, he should gain no profit from such defective statement of that to which he considers he is entitled. Thus, where an inventor applies for a patent upon "an improvement in burglar-proof safes," and his patent is granted in those terms, he cannot thereafter claim that his patent is infringed by a locking device intended for use in jail cages. Gerard vs. Diebold Safe & Lock Company, 61 Fed. Rep. 209. It is possible that the chief distinction between the two devices was that one was intended to keep out persons intent upon taking that which does not belong to them, while the object of the other was to keep them in, but the reason of the decision was that the patentee had not made the language describing his patent broad enough. If the inventor here had asked for a patent "upon an improvement in a locking device for safes, jails and other similar structures," he might have been in a position to successfully claim infringement. In White vs. Dunbar, 119 U. S. 47, it was said, in somewhat mixed metaphor: "Some persons seem to suppose that a claim in a patent is like a nose of wax, which may be turned and twisted in any direction, by merely referring to the specifications, so as to make it include something more than, or something different from what its words express."

Nothing is better settled in the law of patents than that the patentee may claim the whole or only a part of his invention, and that if he only describes and claims a part, he is presumed to have abandoned the residue to the public. The object of the patent law in requiring the patentee to "particularly point out and distinctly claim the part, improvement or combination which he claims as his invention or discovery," is not only to secure to him all to which he is entitled, but to apprise the public of what is still open to them. The owner of a patent for a sweat-pad for horse collars, fitted with a double spring so arranged as to be capable of clasping the collar and thus holding the pad in place, was held to have no grievance which the law would recognize, against one who manufactured similar pads upon which a curved hook performed the function of the double spring. The patentee had limited himself, perhaps unnecessarily, to the double spring arrangement; and, while he was undoubtedly unfortunate in the language which he had chosen to define his invention, the court was not at liberty to construe his patent to include anything more than the language of his claim fairly imported.

If a slight or immaterial variation is introduced into a patented article for the purpose of avoiding the consequences of infringement, and this can be shown or is apparent from the facts, the infringer will not be allowed to rely upon the variation as a defense to an action for infringement. In Devlin vs. Paynter, 64 Fed. 398, the patent covered a union for steam pipes, one of the members of which was fitted with an internal seat of soft metal, the face of which was made concave, the opposing member being fitted with a convex end, so as to conform to the concavity of the seat and form a perfectly tight joint therewith. The device overcame the difficulty arising from want of exact axial alignment. In the device which the patentee claimed to be an infringement of his rights, the position of the soft metal face was transposed to the convex side of the union. This transportation was held to be mere subterfuge, and, although not strictly within the letter of the patent, was declared to be an infringement. Devlin vs. Paynter, 64 Fed. Rep. 398.

Except where the patent covers merely a particular combination of elements, it is an infringement to use any part of the invention embraced within the patent. So also where a patent covers several new and independent machines working to a common end, the use of one alone is an infringement, although each is capable of independent use. In Wyeth vs. Stone, 1 Story, 273, the patent was for a new and useful improvement in the method of cutting ice, together with the necessary machinery and apparatus for cutting by the new method. To accomplish the cutting there were used two different devices, a cutter and a saw. The saw had been abandoned by the patentee as unnecesary or superfluous. In an action for infringement, the patent was held not to be invalid because double, and to have been infringed by the use of the cutter alone.

In an action for the infringement of a patent for a castor and bearings it was held to be an infringement of the patent to make and vend the bearings alone. Blake vs. Smith, 3 Fed.

Cas. 1502. An infringement of a patent for a machine takes place when a party avails himself of the invention of the patentee without such variation as will constitute a new discovery. It is not necessary that the defendant should use the entire machine, for the fact that the patentee claims an entire machine does not deprive him of his rights to the various parts of the machine, and it is an infringement if any one of the parts claimed is used in substantially the same manner and in similar machines. Foss vs. Herbert, 1 Bissel's Rep. 121.

Inventions pertaining to machines may, for the purpose of considering the law of infringement, be divided into four classes. First, where the invention embraces the entire machine, as, for instance, a car for a railway, or a sewing machine. Such inventions are seldom made, but when made, and duly patented, any person is an infringer who, without license, makes or uses any portion of the machine. Under such a patent the patentee holds the exclusive right to make, use and vend to others to be used, the entire machine; and if another, without license, makes, uses or vends any portion of it, he invades the right of the patentee. The second class of machines is that which embraces one or more of the elements of the machine, but not the machine in its entirety, as, for instance, the coulter of the plough, or the divider of the reaping machine. In patents of that class any person may make use or vend all other parts of the machine or implement, and he may employ a coulter or divider in the machine mentioned, provided it be substantially different from that embraced in the patent. The third class of machines is that which includes both a new element and a new combination of elements previously used and well known. The property in the patent in such a case consists in the new element, and in the new combination. No one can lawfully make, use or vend a machine containing the patented part or combination. They may make free use of the machine without the patented parts if it is capable of use; but they cannot use the improvements without making themselves liable as infringers. The fourth class of machines is that in which all of the elements used are old and where the invention consists in a new combination of those old elements, whereby a new and useful result is obtained.

Modern inventions of machines of utility and pronounced value belong to the fourth class, in which the invention consists solely in a new combination. Inventions of this class are just as meritorious as those of any other class, and the property of the inventor is entitled to the same protection. Such an invention, however, is but an improvement on an old machine and consequently the patentee cannot treat another as an infringer who has improved the original machine, by the use of a substantially different combination, although the machine may produce the same result. Union Sugar Refinery vs. Mathiesson, 24 Fed. Cas. 14,399.

The unauthorized application of a patented machine or device, or a colorable evasion thereof, to a new use, without varying the principle or means, is an infringement. Thus, it is no defense to a suit for infringement of a patent that a patented machine is used solely for sewing leather and the infringing device for sewing paper, when either machine might be used indifferently on either material, as a patent covers the exclusive right to use the patented machine for all purposes. Thompson vs. Gildersleeve, 34 Fed. Rep. 43.

In a patented machine the substitution, for one of the parts, of the equivalent of that part, does not avert an infringement. The term equivalent, as used in the patent law, has two meanings, one relating to the results produced by the invention, and the other to the devices or means by which the result is produced, and where used in this connection, it is to be given the latter meaning.

For the purpose of determining whether or not an infringement has occurred, if the patent mentions a specific mode of effecting the prescribed result, the substitution of any one or more mechanical equivalents for those specially mentioned will none the less work an infringement. Whoever adopts the patentee's plan and works out the same results by merely substituting for one or more mechanical devices their mechanical equivalents is just as guilty of infringement as if he servilely copies the patentee's device in all its parts. One thing to be the equivalent of another must perform the same functions as that other, and the function must be performed in substantially the same way. This substantial sameness of way is not necessarily an identity of merit, nor a theoretical scientific sameness. In a purely scientific sense, a screw always performs its function in a substantially different manner from a lever, and in substantially the same way as a wedge. Screws and wedges are equally inclined planes, while a lever is an entirely different elementary power. But screws and levers can practically be substituted for each other in a larger number of machines than screws and wedges can be similarly substituted. When a lever and a screw can be interchanged in a patented machine and still perform the same function with a result that is beneficially the same, they are said to perform the same function in substantially the same way. One thing, however, may be an equivalent for another in one environment, and not such an equivalent in another situation. For instance, springs and weights are generally equivalents; but where the environment is such that a spring will operate successfully while a weight will not so operate, they are not equivalents. In one case the Supreme Court has gone to the extent of holding that a confined column of water in a cylinder, worked by a pump and working a piston, is an equivalent of a combination of a vibrating arm, toggle joint and other mechanical devices, when used to transmit vibratory power. Walker on Patents, 311.

Direct-Current Motors, Their Action and Control—II.

BY F. B. CROCKER AND M. ARENDT.

SHUNT MOTOR PROBLEMS.

The following data of three standard sizes of shunt motors are given, so that the various features of these machines may be studied and the efficiency, effect of temperature, speed regulation, etc., calculated:

RESULTS OF ACTUAL TESTS.

1 HP Machine.	10 HP Machine	110 HP Machine
Rated Voltage V=230	230	230
Rated Current I=4 amps.	38 amps.	384. Amps.
Arm. Current at Rated Load Ia=3.85 Amps.	37 Amps.	380.7 Amps.
Shunt Field Current, Ish=.15 Amps	1 Amp.	3.3 Amps.
Arm. Resist "Hot," Ra=3.1 ohms.	.28 ohms.	.0104 ohms.
Arm. Resist "Cold," $R'a$=2 ohms	.244 ohms	.009 ohms.
Field Resistance "Hot," Rsh=1506 ohm.	230 ohms.	70.2 ohms.
No load armature current, Ia=.4 amps.	2.3 Amps.	14.21 Amps.
Speed at rated load R.p.m. 1250	825.	585.
Speed at no load R.p.m. f=1310	865.	595.
Brush Contact Area, Ab=3 sq. cm.	12 sq. cm.	72 sq. cm.
Current Density of Brushes at rated load Sb=1.28	3.08	5.3
Current Density of Brushes at no load Sb=.126	.19	.20
Drop due to brush contacts at rated load, Db=1.05 Volts.	1.4 Volts.	1.86 Volts.
Drop due to brush contacts at no load, $D'b$= .83 Volts.	.84 volts.	.84 volts

The voltage drops due to the brush contacts have been taken from the curve herewith, which gives the results of actual tests made with a number of brushes similar to those employed in the three sizes of motor specified above.

Calculation of Speed Running Free (1-hp Motor).

It was shown that the speed of a motor is directly proportional to the c. e. m. f. at any instant, other quantities such as field current and flux being constant, hence the ratio between rated load speed and no-load speed (*i. e.*, free) is:

$$r.\ p.\ m. : r.\ p.\ m._f :: c.\ e.\ m.\ f. : c.\ e.\ m.\ f._f \qquad \text{VIII}$$

From equation VII c. e. m. f. $= V - (I_aR_a + D_b)$ in which we substitute the values of V, I_aR_a and D_b as given in the data sheet and obtain c. e. m. f. $= 230 - (3.85 \times 3.08 + 1.05) =$ 217.1 volts at rated load, and c. e. m. f. $= V - (I'_aR'_a + D'_b) =$ $230 - [(.4 \times 2.7) + .83] = 228.10$ volts at no-load. Substituting these values of c. e. m. f. and the rated motor speed in equation VIII, we have 1250 : $r.\ p.\ m._f$ :: 217.1 : 228.1; $r.\ p.\ m._f$ $=$ 1314 r. p. m., which is within .3 per cent of the data value 1310 r. p. m. for the no-load speed.

Speed Running Free (10-hp Motor).

C. e. m. f. $= V - (I_aR_a + D_b) = 230 - (37 \times .28 + 1.4) =$ 218.2 volts. No-load c. e. m. f. $= V - (I'R_a + DD') = 230 - (2.3 \times .244 + .84) = 228.6$. The rated speed is 825 r. p. m., and by substituting in equation VIII, we have 825 : r. p. m.$_f$: : 218.2 : 228.6; whence r. p. m.$_f = 863$, which is within .3 per cent of the data sheet value, 865 r. p. m., for the no-load speed.

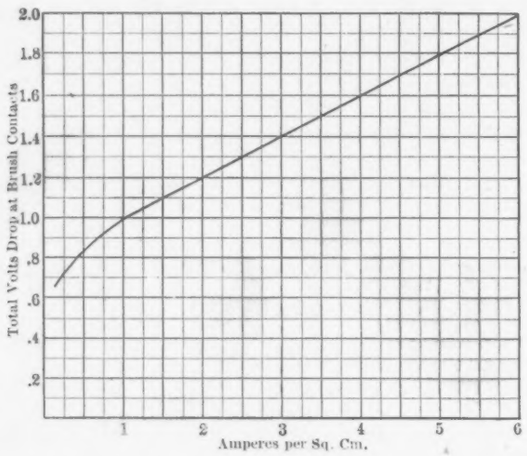
Speed Running Free (110-hp Motor).

C. e. m. f. $= V - (I_aR_a + D_b) = 230 - (380.7 \times .0103 + 1.86) = 224.2$ volts.

C. e. m. f. $= V - (I_aR_a + D_b) = 230 - (14.20 \times .09 + 84) = 229$ volts, and from equation VIII, 585 : r. p. m.$_f$: : 224.2 : 229 or r. p. m.$_f = 597$, within .3 per cent of the no-load speed as given on the data sheet.

Determination of Efficiency of Motor at Rated Speed and Load.

The efficiency of a motor can be obtained approximately from its name-plate data or it can be determined absolutely from the



VOLTAGE DROPS AT CONTACTS FOR CARBON BRUSHES.

values obtained by test and given in the data sheet; usually the two results agree very closely.

The standardization rules of the A. I. E. E. (paragraph 313) state: "All electrical apparatus should be provided with a name-plate giving the manufacturer's name, the voltage and the current in amperes for which it is designed. Where practicable, the kw-capacity, character of current, speed, frequency, type designation, and serial number should also be stated." From the data thus given the approximate or "name-plate efficiency" of a motor can be determined as follows:

From Name-Plate of 1-hp Motor.

Input at rated load $= 230 \times 4 = 920$ watts. Output at rated load $=$ 1 horse-power $= 746$ watts.

Hence efficiency being the ratio between input and output, the name-plate efficiency of the 1-hp motor $= 746 \div 920 = 81$ per cent.

Calculation of Efficiency, Using Data Sheet Values.

In determining the efficiency of a motor by calculation, we first obtain the motor input from the name-plate and then calculate the stray-power and copper losses, using the values given on the data sheet. The difference between input and the total losses gives the output, hence the ratio of input minus losses to input gives the motor efficiency.

The stray power losses of the 1-hp motor running free = armature input at no-load — the armature no-load copper losses; that is, the no-load stray power loss $= VI'_a - (I'^2_aR'_a + I'_aD'_b) = 230 \times .4 - (.4 \times 2.68 + .4 \times .83) = 91.2$ watts.

The remaining losses at rated load are

$$I_{sh}V = .153 \times 230 = 35.46$$
$$I_a^2R_a = 3.85^2 \times 3.08 = 45.64$$
$$I_aD_a = 3.85 \times 1.05 = 4.04$$

85.14

If to this we add the no-load stray power loss of 91.2 watts, the total loss is 85.14 + 91.2 or 176.3 watts. The motor output being equal to the input minus losses $= 920 - 176.3 = 743.7$ watts and the efficiency by definition $= \frac{743.7}{920} = 81.0$ per cent; hence the efficiency by calculation is equal to that by name-plate determination.

The assumption that the stray power losses at no-load are equal to those at rated load is not absolutely correct, since they will be lower at rated speed, which is from 2 to 5 per cent less than with motor running free, but the error introduced by this assumption is practically negligible, as will be proven in the case of the 10-hp motor.

Determination of Efficiency of 10-hp Motor.

$$\text{Name-plate efficiency} = \frac{\text{Output from name-plate}}{\text{Input from name-plate}} = \frac{10 \times 746}{230 \times 38} =$$

$\frac{7460}{8740} = 85.3$ per cent.

Efficiency by Calculation, Using Data Sheet Values.

First determine the various I^2R losses as follows:

$$I^2_aR_a = 37^2 \times .28 = 383.3$$
$$I_{sh}V = 1 \times 230 = 230.$$
$$I_aD = 37 \times 1.4 = 51.8$$

Total I^2R losses $= 665.1$ watts.

The stray power loss with motor running free (*i. e.*, at 865 r. p. m.) is equal to the no-load armature input minus the no-load armature copper loss; that is:

Stray power at no-load $= 230 \times 2.3 - (2.3^2 \times .244 + 2.3 \times .84) = 526$ watts. At rated load the motor is running at a slightly lower speed of 825 r. p. m., hence the stray power loss will be less because the eddy current constituent varies as the square of the speed and the several losses due to hysteresis, windage and friction vary directly as the speed. In standard machines of this size the stray power losses are usually divided as follows: 50 per cent due to windage and friction, 25 per cent due to hysteresis and 25 per cent due to eddy currents. Hence, 75 per cent of the stray power losses vary as the speed, and 25 per cent vary as the square of the speed. The stray power loss corrected for change in speed from 865 to 825 r. p. m. or 4½ per cent will be $(.955 \times .75 \times 526) + (.955^2 \times .25 \times 526) = 495$ watts. If the stray power loss had been assumed to have the same value at no-load speed and at rated load speed the error introduced would therefore be $526 - 495 = 31$ watts, or about .4 per cent of 8740 watts the rated input. This difference is so small that it may be neglected in most practical problems.

The total motor losses employing the corrected stray power value are $495 + 665 = 1160$ watts. Hence the output is $230 \times 38 - 1160 = 8740 - 1160 = 7580$ watts.

The efficiency is, therefore, $7580 \div 8740 = 86.8$ per cent. A comparison of calculated output (7580 watts) and rated output ($10 \times 746 = 7460$) shows that the former is 136 watts greater; so that the manufacturer is on the safe side when the motor is rated to give 10 horse-power, and this is as it should be, overrating of machinery being bad practice.

Effect of Armature Resistance Upon Speed Shunt Motors.

The principal and instantaneous cause of shunt motor speed variation with changing loads is the varying armature current and consequent varying armature drop ($= I_aR_a$); hence the reason for making the resistance of the armature (R_a) as low as possible This cause of speed change is shown by a consideration of the 10-hp motor, data for which have already been given. Assume its armature to be "hot" (75 degs. C.) and let us determine the speed change due to variations of armature current alone. From the data sheet we have $R_a = .28$ ohms, brush drop at no-load .84 volts, at rated load 1.4 volts, and speed at rated load 825 r. p. m., with armature current I_a of 37 amperes and terminal voltage V of 230.

The c. e. m. f. at rated load with armature "hot," but running

free is $230-(.28\times 2.3+.84)=228.5$ volts. Hence from equation VIII r. p. m.$_f=\frac{228.5}{218.2}\times 825=864$, that is the speed changes from 825 to 864 or 39 r. p. m., amounting to 4½ per cent. Thus a speed rise of 4½ per cent results on account of armature drop alone, when the load is removed from this 10-hp motor.

Effect of Temperature Changes Upon Speed of Shunt Motors.

Heating of armature affects the speed only to a slight extent, and may be practically neglected. For example, in the case of the 10-hp motor, the cold armature resistance is .244 ohms; the hot armature resistance with a temperature change from 25° to 75° C. (*i. e.*, 50° C. rise being permissible), is 15 per cent greater (see Section 6) or .28 ohm. The speed change at rated load due to this heating is determined as follows:

C. e. m. f. with armature cold at rated load $=230-(37\times .244+1.4)=219.7$ volts, the c. e. m. f. with armature hot and at rated load being 218.2 volts; hence the speed at rated load and with armature cold is $219.7\div 218.2\times 825=830$ r. p. m. instead of 825 r. p. m. when the armature is hot, an increase of .6 per cent, which is not material in most practical cases, the change due to varying load being 4½ per cent as shown above.

Change of Speed Due to Heating of Field Circuit.

The allowable temperature rise in the field winding is 50° C., causing a 19 per cent increase in the resistance, or cold resistance is $\frac{R_{sh}}{1.19}=\frac{230}{1.19}=193.3$ ohms.

Current in field (hot) $I_{sh}=\frac{R_{sh}}{V}=\frac{230}{230}=1$ ampere.

Current in field (cold) $I_{sh}\frac{V}{R'_{sh}}=\frac{230}{193.3}=1.19$ amperes. Hence the current in the coils cold is 19 per cent greater than when the latter are hot; and from magnetization curves of standard types of shunt motors a rise of 19 per cent in field m. m. f. causes an increase of about 4 or 5 per cent in the flux, or the field is this amount stronger "cold" than "hot." With other conditions (such as n, V, I_a, p *and* b) constant the speed (N) will vary inversely with the flux as proven in the following:

$$e=\frac{\phi nN2p}{10^8\times 60\times b} \quad \text{or} \quad N=\frac{e\times 10^8\times 60\times b}{\phi n2p}$$

Hence with the flux 4 per cent to 5 per cent stronger with field winding cold, than with it hot, the speed is 4 per cent to 5 per cent lower. This variation of speed with heating of the field winding is a weak point of the ordinary shunt motor for work requiring almost perfectly constant speed, such as weaving. It can be overcome by employing so highly saturated a field that a moderate change in field current produces only negligible flux variation; or a field winding with a zero temperature coefficient wire would secure a like result, but both methods are, however, too costly.

Effect of Armature Reaction Upon Speed of Shunt Motors.

The counter m. m. f. due to armature current decreases the field flux and the value of these back-ampere-turns varies somewhat with different designs. In fact some designers have suggested that armature reaction be employed to offset the effect of armature drop (I_aR_a) and thus cause the motor to maintain an almost constant speed from no load to full load. The objection to this design would be, under usual conditions, as follows:

1. Excessive armature reaction at starting under load, weakened field and resulting sparking.

2. Inability of machine to run well on continued or even momentary overloads due to weakened field and sparking.

3. Heating caused by the above stated sparking.

In the usual design of standard single-speed shunt motors the ratio of back ampere-turns to field ampere-turns at rated load seldom exceeds 8 per cent to 10 per cent, hence the rise in speed due to armature reaction would correspond to a change of only 1 per cent to 2 per cent in flux, depending upon the flux density at which the machine is operated. However, by designing the armature winding so that there will be few turns of wire per section, with a very high flux density in the teeth and high resistance brushes, the above difficulties do not occur when armature reaction is depended upon for speed regulation.

Collecting these various causes of speed variation of this standard 10-hp motor, we obtain the following table:

Cause.	Armature Drop (inclusive of brush drop).	Armature Reaction.	Armature Heating.	Field Heating.
Per cent Speed change	—4½	+1½	—.6	+4 to 5

In the case of larger motors armature drop is slightly smaller, the field heating effects being also slightly less while the other factors remain about the same. It is important to note that the effects of armature drop and armature reaction are instantaneous, whereas heating requires several hours to reach its maximum effect. Hence the immediate effect of applying rated load to a motor is to reduce its speed ($-4.5+1.5=-3\%$), after which as the machine heats up the speed slowly rises to about the original value ($+4.5-.6=+3.9\%$).

Construction of Joint Pole Lines.

In a paper delivered before the Western Association of Electrical Inspectors at its third annual meeting, held at St. Paul, Minn., on Oct. 23, Mr. H. B. Gear gives some information on the joint pole line arrangements in effect in Chicago between the various operating companies.

The lighting wires are carried on the top of the pole with a clearance of five feet between the lower cross arm of the lighting company and the upper cross arm of the telephone company. The lighting company's transformer is allowed to encroach on the clearance space, provided that at least 3½ ft. is maintained between the bottom of the transformer and the top telephone wire. Ground wires on secondary lines and lightning arresters are covered by a half-round wood molding for the protection of linemen as well as to prevent the possibility of any stray current being communicated from the ground wire to the telephone system.

The telephone company limits its open-wire equipment to two cross-arms and a service buck arm in outlying districts, and to one-cross arm in the more congested districts. Cables are used for the transmission up to within a block or two of the location of the telephone served. This avoids the necessity of extra cross-arms for through lines and greatly reduces the possibility of crosses with lighting services or high-tension wires. A clearance of 2 ft. is maintained on the sides of buildings between lighting and telephone services. Where underground lighting cables are brought up a pole, the iron pipe is extended to the top of the clearance space.

The major portion of the distributing systems of the lighting and telephone companies in Chicago is carried in alleys, which makes it unnecessary to utilize the streets except for through lines. The latter are in many cases carried underground on the streets with lateral connections at the alley intersections for the distributing lines.

There is some advantage to both companies in joint pole arrangements from the standpoint of investment. The operating advantages are, however, considered such by the Chicago companies that old lines are reconstructed in preference to erecting a second line on the opposite side of the thoroughfare.

The use of joint pole lines has, however, some objections which may not be overlooked. The service of each company is likely to be interfered with by the employees of the other company. It is, therefore, essential that the relation between the employees interested should be friendly and a spirit of forbearance must exist at all times.

The arrangement in effect in Chicago may be outlined briefly as follows: Each company, when it proposes to make any extensions of its lines, notifies the other company by letter of

its intention, giving a description of the number, size and location of poles, which it intends to erect. Several copies of these letters are passed between the companies so that each situation may be looked over by the foreman or inspector, who makes a recommendation as to whether or not he considers it advisable for his company to take an interest in the poles which are to be set. If the foreman of the other company desires larger poles he may ask for the same, and they will be set as requested by the other company. Payment is then made on the basis of the number of gain spaces reserved for the use of each company.

If the other company does not feel that it will require space on the poles within a reasonable time, it reserves the privilege of refusing to take an interest in the poles which are to be erected.

In case one company wishes to extend its lines where the other company already has a line, it will ask for space on the existing poles if they are high enough, and will attach its equipment after agreeing to purchase from the other company an interest in the poles concerned. In case the poles in the existing line are not tall enough for the equipment of both companies, the incoming company replaces the existing poles at its own expense, taking the old poles as salvage and paying the other company the expense incurred by it in transferring its equipment from the old to the new poles. The new poles are then jointly owned by the two companies.

The expense of maintenance of joint poles is shared by the two companies in proportion to their interest in the pole.

In cases involving work where separate parallel lines exist representatives of each company agree upon a suitable arrangement for the consolidation of the existing lines into one joint line.

In general, the lighting company is apt to bear the greater portion of the expense, owing to the fact that it must pay for the lowering of the other company's equipment and also because the lighting lines are usually preceded by telephone lines so far that the lighting company cannot forecast its requirements with sufficient accuracy to derive the benefit of taking an interest in the poles when they are originally set.

The safety of the lives of employees and the public, as well as the diminished fire risk, are well established by the fact that hardly a single serious case of trouble has occurred in seven years of operation of joint lines. This record has been made on lighting and telephone systems which have been rapidly extended until there are at the present time about 25,000 poles jointly occupied by the wires of the Chicago Lighting Company and the Bell Telephone Company.

Joint arrangements are also in effect on about 2500 poles with the city telegraph and street railway companies. In addition to this, the city of Chicago has the privilege of attaching its wires for electric light, fire alarm and police telephone systems. In general, all signaling systems are kept on the telephone company's portion of the pole and all lighting or traction systems on the lighting company's portion of the pole.

Cases of triple occupation, in which the city is the third party, are numerous, but triple occupation with other companies is not frequent.

The author realizes that methods which can be applied in metropolitan work are not always suitable for smaller cities on account of the limited resources of the companies involved. In cities where the main runs cannot be carried underground, separate routes on high poles should be established for these by each company and the distributing lines may be carried well below the through lines. As far as possible the through lines of the telephone company should be carried in aerial cable.

The presence of two sets of telephone distributing systems is at best a deplorable condition from either standpoint and joint construction of the three companies involved in such situations is not practical under existing conditions, though entirely feasible from a construction standpoint. Conditions can be somewhat improved by the encouragement of one of the telephone companies to operate jointly with the lighting company.

The Malden Electric Company's Laboratory.

An interesting central station laboratory is in service at the present time at the plant of the Malden (Mass.) Electric Company. The value of a laboratory or special testing department in central station work is greater to-day than ever before, on account of the greater range of service supplied by electric light and power companies and the increased importance of being able to determine accurately the errors of meters and the candle-powers of disputed lamps. In these days of anti-corporation agitation on the part of the public, the maintenance of a standardizing laboratory at or near the central station can be made a valuable demonstration of a company's intentions in the way of fairness in supplying metered service. Perhaps no question is more an issue between lighting companies and their consumers than the accuracy of meters, and the provision of complete testing facilities in a special room set apart for investigation work alone is a wise policy for an operating company to adopt. Tests on the consumers' premises are useful, but if anything is radically wrong with the equipment, the laboratory offers much better facilities for the removal of trouble.

A general view of the Malden laboratory is shown herewith in Fig. 1. The department occupies two rooms on the second floor of the storehouse adjoining the main station at Malden. The main laboratory is about 33 ft. long by 23 ft. wide in extreme dimensions, and the second room, which is a section of the main laboratory partitioned off into a space about 13 ft. by 7 ft., is used as a photometric laboratory. The laboratory

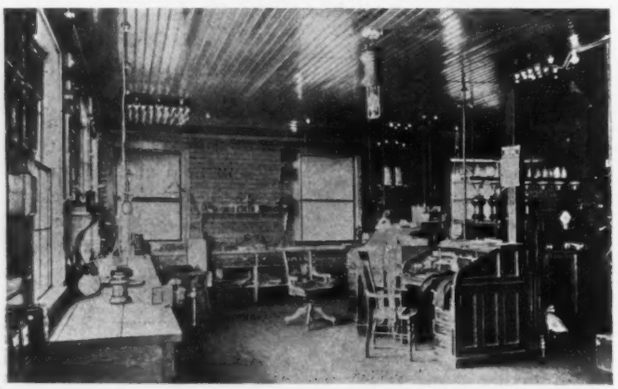


FIG. 1.—GENERAL VIEW OF LABORATORY.

is provided with windows on three sides and is wired for all the regular tests which have to be made on apparatus which has fallen under suspicion. Almost all the work done is of a special nature as contrasted with the routine testing in a manufacturer's laboratory, where the product passes through inspection and test continuously. The same tests are repeated often at Malden, but they are almost entirely for the purpose of settling disputed points, following up the value of special schemes in apparatus arrangement, and testing the condition of apparatus which has been brought in for repairs or adjustment.

The scope of the regular work at Malden includes tests of arc and incandescent lamps, tests of meter accuracy, transformer insulation, and occasional efficiency, heating and insulation tests of small motors up to about 5 horse-power. Defective flat irons, fuses and other small appliances are tested when necessary, and the laboratory is available for any special studies or comparisons which the officials of the company desire to have made. In the practice of the Malden Electric Company very little new and guaranteed apparatus is tested as it is received, but any trouble showing itself in service is promptly investigated. The laboratory is not open at all hours of the day, as the staff are regularly occupied part of the time in motor and meter tests in the territory served by the company.

Figs. 2 to 6 illustrate in diagramatic form the principal testing circuits in the laboratory. As the entire distribution system of the Malden Company is operated at 2300 volts, single-

phase, or 550 volts, three-phase, no direct-current lines enter the laboratory. In one corner of the room, however, is installed a Holtzer-Cabot motor-generator set consisting of ½-hp, 104-volt motor direct-connected to a 30-volt, 8-ampere generator making 1800 r. p. m. This is ordinarily used for charging the sparking batteries used in automobile work, and can be turned to account for other purposes if desired. The principal supply circuits are a 104-volt, single-phase line for testing single-phase meters; a 2300-volt, single-phase line for arc lamp tests, and a 550-volt, three-phase circuit for testing meters. The frequency is 60 cycles.

All the laboratory apparatus is kept well out of the center of the room, being located on or beneath benches, suspended

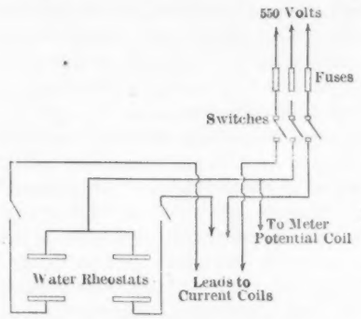


FIG. 2.—THREE-PHASE METER TEST.

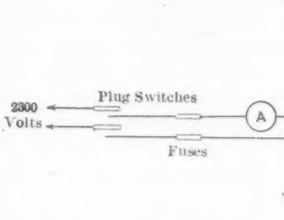


FIG. 3.—SERIES ARC TEST.

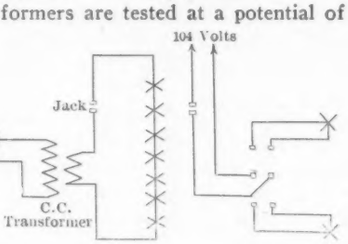


FIG. 4.—MULTIPLE ARC TEST.

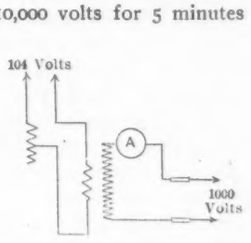


FIG. 5.—1000-VOLT INSULATION TEST.

from special brackets or supported on stands carrying it above the floor and out of casual reach. The 2300-volt circuit for testing series enclosed-arc lamps enters the room at one side, and as shown in Fig. 3, passes through the plug switches, fuses and an ammeter to a constant current transformer mounted about 5 ft. above the floor. This ammeter is permanently retained in the primary circuit, as it gives a constant cautionary indication of the condition of the circuit. Provision has been made for testing seven arc lamps at once if desired. The lamps are hung from a special platform attached to the ceiling by four iron rods, and at one side space is provided for testing two multiple enclosed arc lamps, one at a time, as the circuits are now arranged. The circuit of the series lamp test contains an ammeter jack, and the multiple test circuit is also fitted with

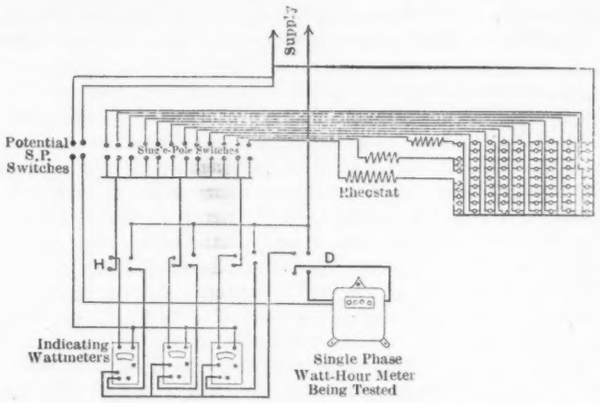


FIG. 6.—DIAGRAM OF CONNECTIONS ON METER TESTING BOARD.

a jack, the same ammeter and voltmeter being used on both classes of work. The arc lamp tests include a 1000-volt insulation breakdown trial, test for open circuits, operation of contacts, feeding and pick-up mechanism, working of dash pots and weight adjustment. Comparative life and quality tests have been made here, and recently a series of tests was made on the life of an aluminum gas cap for use on top of inner globes, which worked out favorably in point of durability. The series lamps used on the Malden circuits take 6.6 amperes each and are sent out of the laboratory adjusted to 72 volts across the arc. The 1000-volt arc lamp insulation test is made by a circuit supplied from a small transformer located under one of the benches in the corner of the laboratory nearest the suspended arc-lamp base board. A rheostat is inserted in the primary circuit and an ammeter in the secondary circuit of this transformer to enable the current to be held below the fusing point in case of a ground in the lamp mechanism. By adjusting this rheostat a small ground can be burned off if desired. A ¼-hp Emerson motor wound for 104 volts is used for polishing work.

Insulation tests on transformers are made by a General Electric high-potential 500-volt outfit mounted in an oil bath and located in a recess cut into one of the benches near the floor level. This transformer is wound for either 50 or 100 volts primary and 10,000 volts secondary, and is provided with a micrometer spark gap with terminals for the testing lines and a water rheostat for control of the primary current. When the cover of the spark gap is removed, the primary circuit is broken, as a safety precaution. All defective or doubtful transformers are tested at a potential of 10,000 volts for 5 minutes between primary and secondary, with the secondary grounded to the core and case. A voltmeter is provided in the primary circuit as a check on the spark gap, the latter varying in its reading with variations in the atmospheric conditions.

All meters are made correct to within one-half of one per cent before they are returned to service. The usual stop-watch calibration of accuracy in the number of revolutions with definite constant loads is employed in all meter tests. When necessary artificial loads are secured by the use of series transformers. The standard connections of the laboratory for testing meters under load are shown in Fig. 2. A three-phase, 550-volt circuit is carried through fuses and a switch to the meter under test, the current coils of which are respectively connected to the outside and inside pairs of wires marked "leads to current coils." The middle phase wire is carried past the meter, with a potential tap taken off, to the center of a jumper wire connecting two corresponding water rheostat plates. Two rheostats are located in tanks supported on insulators mounted on a platform outside the laboratory window, the platform being enclosed with a hinged cover adjustable from the inside of the window. The plates farthest away from the window have a potential difference of 550 volts between them and the end plates in each tank are likewise at different potentials. This brings the plates nearest the window and joined by the jumper to the same potential and makes a shock impossible in moving them in and out. The plates are hung by insulators from a cross bar carried by rollers, small brass rods being used as rails lengthwise of the rheostat tanks. According to the amount of chlorine given off, the rheostats may be completely shut in or opened to the outside air. The maximum capacity of the outfit is about 50 amperes per phase.

Fig. 6 shows in detail the testing circuits for calibrating single-phase watt-hour meters. Current enters the laboratory at 104 volts for this purpose. Attached to the ceiling over the testing bench is a lamp bank composed of some 90 incandescents arranged in rows. Five of these lamps are "Meridians," the balance being 16-cp units, arranged to form an adjustable resistance and controlled by small single-pole, vertical-throw knife switches mounted on a panel within convenient reach of the tester. Three standard indicating wattmeters are provided for comparison of different sizes of meters, the scales reading to 500, 1500 and 7500 watts, respectively. The meter to be tested is placed in circuit at *K* and the horizontal, double-pole knife switch *H* supplies the indicating meter which is to be

used for checking. The tested meter is controlled by the switch *D*. One side of the supply circuit passes to a bus-bar on the lamp bank, and after the current is passed through the lamp resistance and switch which makes the desired combination, it passes through the particular switch *H* selected and then through the standard and tested meters back to the line. Besides the single-pole knife switches, which produce broad changes in the lamp bank connections, rheostats are inserted in the circuits to permit gradual adjustment of the load, the handles being located close to the testing stand. By means of series transformers artificial loads of 75 to 100 amperes can be tested on large meters; but the normal capacity of the testing circuits covers meters of from 5 to 50 amperes. The company keeps at the laboratory for exact comparison of the standard meters a precision dynamometer which is calibrated once a year at the factory and also a precision wattmeter and ammeter. The 0.500 indicating wattmeter is so frequently used that it is mounted on a stand on top of the test bench; the other two meters are on a swinging bracket which is located beneath the bench when not in use.

The photometer room contains a Queen photometer with motor-driven lamp stand adjustable for different degrees of angular rotation, with permanent ammeter, voltmeter and rheostat connections. The precision instruments are kept in this room together with Queen standard incandescent lamps used in photometric comparisons.

Electric Power Application in Small Sewage Pumping Plants.

At a recent meeting of the sanitary section of the Boston Society of Civil Engineers a discussion was held following the reading of a paper on "Small Pumping Plants for Sewage," by Mr. Irving T. Farnham, of Newton, Mass. During this discussion the problems of electric power application to small sewerage pumping plants were very frankly handled, and in view of the increasing importance of this kind of load for central stations a résumé of the electrical portion of the discussion is given below.

Mr. Frank A. Barbour pointed out that the great argument against pumping in the case of small installations has been the labor charge. With steam pumping local attendance at each station is required and a storage capacity limiting the pump run to certain hours is necessary. To localize the labor at one point compressed air is of considerable value, but of doubtful economy and limited usefulness. The more nearly continuously a pumping plant can be made to operate at a uniform rate, the more economical is the result, provided the labor account does not offset the saving in the decreased storage capacity, lessened size of force main and reduced friction head thus made possible. With a steam plant a reservoir large enough to hold the sewage during the hours the pumps are not running, and a force main adapted to the pump rate, are required. If the amount of sewage to be handled could be accurately predicted and a pumping unit with a capacity equal the average daily discharge adopted, then a reservoir only large enough to equalize the hourly variation would be necessary. This cannot practically be done, and the nearest approach to uniform discharge is obtained by dividing the plant into such a number of units as will most nearly approximate in their capacity the rate of inflow; that is, by dividing the total power into units best capable of handling the load curve. With such an arrangement, the reservoir can be reduced to a size only sufficient to prevent too frequent a starting and stopping of the units, and the force main designed on the basis of the maximum rate of inflow for the period in the future which it is economical to consider. This continuous discharge is often extremely desirable in disposal work where either purification is effected or the sewage disposed of by dilution.

Such frequent starting and stopping practically necessitates automatic arrangements, and for this electric motors are practically the best adapted. Such plants can be electrically operated with practically no attendance except for oiling and examination of switches.

The plant at Saratoga, N. Y., is of the type above described, consisting of three units of 20-hp induction motors, direct-connected by vertical shafts to three 6-in. centrifugal pumps, the pumps being submerged in three separate wells, with floats in these wells arranged to stop and start the motors by the rise and fall of the sewage. The capacity of each unit is 1500 gals. per minute with one pump working against a head of 28 ft.; 1200 gals. per minute with two pumps working against 38 ft., and 1000 gals per minute with all three pumps against a head of 42 ft. The combined efficiency of pumps and motors was by test proved to be about 35 per cent. The capacity of the pump well is 10,000 gals., or only sufficient to balance the operation of the machinery. The amount of sewage varies daily from 1,500,000 to 3,000,000 gals. The cost of the plant was $5,400, including pumps, motors, automatic starting apparatus and all interior piping and valves.

At Hudson, Mass., two 15-hp, three-phase, 60-cycle induction motors, direct-connected to 5-in. centrifugal pumps by verical shaft, serve to lift the sewage to the elevation of the disposal plant. The current is supplied at 500 volts through transformers. In this case the pumps are set in dry wells at an elevation below the height to which the liquid rises in the adjoining sewage well, with suctions laid through the dividing wall into this collecting well. The pumps are therefore dry and accessible for use, ready primed with each rise of sewage in the collecting well. The normal capacity of the pumps is 500 gals. each when two units are working against a total head of 35 ft. The combined efficiency is a little over 42 per cent. The cost was $3,600 complete, including motors, pumps, piping and control.

Wherever vertical shafts are used, the division of the moving parts of the motor and impeller thrusts by a slip coupling is desirable. The thrust bearing for the vertical shaft is an important element in the design. At Saratoga, where a bearing of several inches in diameter with alternate loose rings of brass and steel submerged in oil, was employed, considerable trouble was encountered because of heating. At Hudson a regular marine propeller bearing, with an oil-collecting pan, and the oil lifted and circulated by centrifugal force, was used with entire success. In both the Hudson and Saratoga installations time limit relays have been installed, which automatically cut out the current in case of stoppage of the motors or burning of the switches. The floats are so set that the first pump starts with the sewage at a certain level, and if the inflow is greater than the capacity of this pump, the sewage rises to the level where it operates the float governing the second pump. This second pump, coupled to an alternating-current motor, runs at constant speed, and starting against a closed check with no discharge, develops the necessary pressure to lift the check and begin pumping. Where energy is drawn from a lighting circuit the starting current of the motor may dip the lights for a fraction of a second unless special apparatus is inserted in the line to prevent this action. Alternating-current motors started and stopped automatically, cannot be varied in speed with success. With a certain frequency and number of poles a practically fixed number of revolutions per minute results. The variable factor in obtaining the desired pump capacity is in the radius of the impeller. Motors with a multiple number of poles can, however, be obtained, the number being changed by the attendant so as to change the speed in inverse ratio to the poles in use. With direct current the series-parallel method of control can be utilized to vary automatically the speed in such a way as to adapt discharge to inflow within certain limits. Where direct current is used, the motors cannot safely be subjected to the same overload as with alternating motors, and in order to prevent commutator difficulties under the torque developed in starting centrifugal pumps, large relative motor capacity must be provided.

At Fredericton, N. B., a plant consisting of two 15-hp motors direct-connected by vertical shafts to two 5-in. centrifugal pumps, is being installed to pump the sewage during such

period as the river is above the elevation of the outlet of the sewer. The plant is designed to discharge 500 gals. per minute against the maximum height of water in the river. This height varies 20 ft., and with the short force main, is the governing factor in determining the load. In this case, however, with constant circumferential speed, it is found that the maximum load on the motor occurs not with the maximum head, but with a lower head. This is because of the fact that with a centrifugal pump the discharge increases in greater inverse ratio than the reducing head, and the maximum load occurs at some intermediate point between maximum and minimum head, the exact point depending upon the pump characteristic, which depends upon the curve given to the impeller. Each centrifugal pump has its own characteristic and a breaking-down point beyond which the discharge will not increase beyond the inverse ratio of the head. This is a phase of the problem which must be taken into account wherever the load is liable to change, either because of a varying difference between source of supply and point of discharge, or in the case of a force main which may empty because of reduced friction head at the time of starting the pumps. Unless care is taken in the selection of the impeller curve it is possible under reduced head to bring such a load on the motor as to burn out the windings. The cost of the Fredericton plant was $4,000 and the guaranteed efficiency 52 per cent. It should be noted that high efficiency in handling sewage sometimes increases the tendency to clogging of the pumps because of the decreased impeller clearance necessary, and it is sometimes better to adopt a pump of lower efficiency or one requiring less screening.

One of the advantages of electric pumping is the possibility of placing the entire pump outfit below the ground surface, and without the building. In Atlantic City, because of the flat character of the country and because of the small elevation of the streets above tidal level, several pumping stations are installed. These are placed below the streets or sidewalk, the stations being lighted through the roof with glass sidewalk lights. The plans provide for the raising of the screens for clearing by hydraulic lift above the elevation of the ground in a manner similar to the sidewalk elevator.

At West Chester, Pa., the peculiar topography of the city renders impossible the collection of sewage at one point, making it necessary to install two stations. These are similar to the Hudson and Saratoga plants, but use single-phase current.

Where a number of small plants are to be installed, widely distributed in location, and where energy can be obtained at a reasonable cost, the automatic possibilities of electric operation usually render the electrical method the most economical and advisable. At Saratoga, where energy is obtained from Spiers Falls, there is no doubt that in actual cost of energy this plant is far more economical than would be possible under any other method. At Hudson the energy is in greatest demand for pumping at the hours when the lighting load is at a minimum, which serves to smooth out the load line. In such a case a rate of 2 or 3 cents per kw-hour is possible. The possibility of small, artistic stations, odorless and noiseless, without chimney or exhaust pipe, is a feature to be counted in favor of electric pumping, particularly in summer resorts or high-class residential districts. Electric pumping is thus sometimes made possible where steam or gas-engine plants would not be tolerated.

Mr. F. H. Hayes referred to a motor-driven sewerage plant at Pittsfield, Mass. This is a triplex, horizontal pump; it handles 3500 gals. per minute, and delivers this amount of sewage through 2400 ft. of 24-in. pipe. Energy is supplied by the local central station for an 8-hour day-time run at a very reasonable price, and if a larger run is required, an extra charge is made. The plant has been in operation 5 years, and an 8,000,000-gal. triplex pump was recently ordered to extend the installation. Mr. Hayes emphasized the desirability of inspecting smaller plants every 3 or 4 hours.

Mr. Bertram Brewer cited a new plant under construction at Waltham, Mass., which consists of two 5-in. pumps and two 15-hp motors of the alternating-current type, working against about 40 ft. maximum head. Mr. Brewer stated that there is room for improvement in automatic starters, it being an extra expense where heat is needed to keep water from freezing or oil from congealing. Mr. A. J. Garrett also contributed a brief description of a plant at Plainfield, N. J., consisting of two 10-in. x 6-in. Ingersoll-Rand air compressors, driven by two 7.5-hp Wagner motors, with a Fairbanks-Morse gasoline engine as a reserve, and two air-operated displacement pumps. The plant is guaranteed to handle 250,000 gals. in 16 hours against a static head of 13 ft. and cost $4,655, exclusive of the concrete operating chamber.

Coil Insulation in Electrical Apparatus.

At the sixteenth meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers, Mr. J. A. Jacobs presented a paper with the above title which contains much of interest to the operating engineer. The first cost of a machine for a given output depends largely upon its rating, and that depends, in turn, on the allowable temperature rise in the coils, and thus upon the temperature which the insulation of the coils will stand without rapid deterioration. From this it follows that the quality of the insulation is of prime importance to users and manufacturers of electrical apparatus.

For convenience, the subject is divided into three classes: First, the insulation on the wire; second, what might be termed the internal insulation of the coil, the insulation which fills in between the turns of insulated wire, usually after the coil is wound; third, the external insulation, which goes over the outside of the coil and insulates it from the metal of the machine and prevents the grounding of the coil.

The first class of insulation, namely, the insulation on the wire, is a very important part of the insulation of the coil. Mechanically, it should be hard, tough, elastic and uniform in thickness. It should be chemically inert, non-hydroscopic and not affected by high temperatures. At the present time there are several materials to choose from, all of which have been used more or less, and each of which is satisfactory for certain classes of work. There is no material, however, which fully satisfies all of the requirements.

The materials most commonly used at the present time for covering wire are cotton, silk, asbestos and enamel. The most serious defect of cotton is the rapidity with which it deteriorates at temperatures above 125 deg. C. It is also a poor insulator, very hydroscopic, and not strong mechanically. The cotton covering really acts more as a spacer for the wire than as an insulator. In spite of these defects, if reinforced with compounds and varnishes, cotton gives satisfactory results when the temperature is well below 100 deg. C.

Silk is better than cotton in that it takes less space in the coil, and is often used on coils where the space factor is a more important consideration than the extra cost of the silk.

Asbestos covering for wire is being used quite extensively where ability to withstand high temperatures is the prime consideration. Asbestos is poor mechanically, is very hydroscopic, not a very good insulator, and is expensive, but wherever outside limitations make it difficult or impossible to prevent excessive temperature rise the use of asbestos wire is often justified.

Enameled wire is a material which is coming into use quite rapidly and will probably eventually supersede cotton or silk-covered wire for most purposes. Theoretically, enamel is very well adapted for insulating wire. While already enameled wire has been brought to a high degree of perfection it will doubtless be still further perfected. Enamel has a high insulation, is non-hydroscopic, and will withstand a higher temperature than cotton or silk, and, most important of all, in some classes of work, it takes up much less room than other materials used for insulating wire, even less than silk, and is thus very valuable in coils wound with a large number of turns of small wire. With enameled wire it is often possible to give a machine a higher rating, or to allow greater overloads, and thus effect considerable saving in the construction of the

machine. The danger in enamel wire lies in its tendency to crack when bent around small turns, especially in large-sized wire, and also in its tendency to become brittle.

For the great mass of work, such as the field coils on direct-current machines, armature coils, and, in fact, most of the coils used in dynamo-electrical apparatus, cotton-covered wire is used at the present time. In the future, as enameled wire becomes more and more perfected, it is quite certain to supersede cotton on field coils, especially where small space factor is of great importance.

For arc lamp coils, induction coils, for a large part of the coils used in telephone work, and, in fact, nearly all coils wound with very fine wire, enamel will be found to be most satisfactory, provided the wire is properly covered.

In street railway coils asbestos is being used to a considerable extent, on account of its ability to withstand the higher temperatures due to the severe conditions surrounding this class of work.

For transformer work, cotton-covered wire is still very largely used, although enamel wire has been used to some extent with fairly satisfactory results.

For the internal insulation of coils solid compounds, known as impregnating compounds, paints, varnishes and sometimes sheet material, such as paper or mica or varnish cloth, which separates the different layers of wire, are used. The material must have good insulating qualities and its mechanical properties should be such as to cement the coil into a solid mass and prevent the rubbing and vibration of the wire in the coil. The material should not become brittle and powder under heat and vibration, should be oil and moisture proof, and of such a nature as to help conduct the heat from the interior of the coil to the surface. It should be chemically inert so as not to attack the copper; should be non-hydroscopic to prevent the absorption of moisture in the coil, and should be oil proof, if possible, so that it will not be dissolved by the lubricating oils which are nearly always present. Above all, it should not be affected by the heat at the ordinary operating temperature of the coil, and it must be of such a nature that it can be applied to the coil in a satisfactory manner without too great a delay in time or too great an expense.

The materials available include varnishes of different characteristics, including baking, air-drying and paraffin compounds, papers, mica and solid impregnating compounds, both oil and waterproof.

For the internal insulation of stationary coils the best method is to fill the space entirely with a solid impregnating compound by means of the vacuum drying and substituting process. This method has not proved very satisfactory for use on coils which revolve at high speed, as there is a tendency for the compound to soften under high temperature and be thrown outward by centrifugal force.

In the insulation of transformer coils this method of treating with the solid compounds is very satisfactory, if the proper compound is used. As most of the transformers used at the present time are oil-insulated, it is very essential that the compound used should not be affected by the oil in the transformer. If the compound is absolutely oil-proof and has the other necessary characteristics, then the coil produced by this method is much better than can be produced by any other method of insulating.

In addition to the solid compounds, the materials most commonly used for internal insulation are paraffin compounds and oil varnishes. Paraffin is a good insulator, and is very good in preventing the absorption of moisture. Paraffin compounds are defective in that they are very poor mechanically, that they soften up under heat, that they are very soluble in mineral oils, and do not have very high insulating qualities. Paraffin compounds are being used to some extent for the insulation of armature coils and field coils, but on account of their defects they have never been a serious rival of the more commonly used classes of varnishes known as oil varnishes.

One great defect in the use of all varnishes is the fact that volatile thinners, such as benzine, naphtha, etc., are used to a considerable extent. These thinners will penetrate into the coils and when the coils are baked they are driven off, leaving the inside of the coil more or less porous, and this space allows more or less moisture or other injurious substances to enter the coil. To remedy this defect there has recently been placed on the market a line of insulating compounds which contain no benzine or naphtha or other volatile thinners. These may be used in conjunction with the vacuum drying process or they may be used in the way similar to insulating varnishes, with the exception that the insulating compound should be kept warm in order to give it the proper fluidity and penetrating qualities. Not only do these materials fill the coil more solidly and give a better insulated coil, but they also do away with the danger of fire or explosion in the dipping room, which is always present where volatile thinners are used. Also by avoiding the use of volatile thinners quite a saving is effected, as all volatile thinners used in varnishes pass off in the baking of the coil or evaporate from the surface of the tank in which the varnish is contained. In the use of oil varnishes the question of drying out the coils thoroughly before and after dipping in the varnish is very important. For best results, it is preferable to use a flexible baking varnish, and give it a thorough baking in a good oven.

The internal insulation of a coil is often reinforced by paper or mica strips, which are placed between the layers of wire. This practice is very common, especially in transformers and wherever the voltage between layers is greater than the insulation of the wire alone will safely withstand.

The external insulation of a coil includes that part of the insulation which is wound on the coil, usually after the coil is taken from the former. This insulation is sometimes separate from the coil, as in the case of slot insulation used in a direct-current motor armature winding. Also in transformer work the external insulation is often strengthened by means of heavy paper or mica insulation, which goes on the outside of the coil between the coil and the iron. In field coils the external insulation is now largely wound on the outside of the coil, usually in the form of cloth or paper or asbestos tape, or a combination of the three and all thoroughly covered with varnish.

There are a large number of materials which are satisfactory for external insulation, including heavy canvas tape, cotton tapes, asbestos tapes, different preparations of paper or mica, also fibers, etc., all of which may be used in the external insulation of the coil. These materials also should be reinforced with a good baking insulating varnish or, at least, a varnish which is oil and moisture-proof, and which has good insulating qualities.

The great limitation to the improvement of the coil insulation is due to the temperature limits necessitated by the nature of the wire insulation. If materials could be obtained which would be satisfactory in all other respects and would not be injured at a temperature of, say, 250 or 300 degs. C. or higher, then a much higher operating temperature could be allowed in electrical machinery and thus give the machines much higher ratings and allow heavier overloads. This would mean a large saving in the cost of electrical apparatus for a certain output. In order to make any great advance the cotton covering for wire must be discarded, and at present one of the most promising outlooks is in the direction of some form of enameled wire. The enameled wire which is on the market at the present time will withstand a considerably higher temperature than cotton, and thus a higher temperature limit may be allowed. As yet, however, enameled wire has not been sufficiently perfected so that it can be safely used in all classes of work, especially in armature work, so that the old temperature limits which were in force when cotton was used exclusively are yet in force. The time may come when a coil can be produced which will be as indestructible as reinforced concrete and satisfactory in every other respect. When that time comes, as it surely must, apparatus can be built which will be practically indestructible, and the old trouble of burnt-out coils will be largely done away with. This is the problem of the insulation engineer—to build a well insulated, indestructible coil at a reasonable cost.

Operating a Small Electric Plant.

BY W. H. WAKEMAN.

Twelve years ago I was in charge of a steam power and heating plant in which electricity was not used. About that time the idea of using electric lights was agitated and the subject was interesting, because the dynamo would be put in the engine room in case it was decided to install one. Under such conditions there is a choice of two courses open to the engineer. One is to show intelligent interest in the matter, pointing out the advantages of certain machines, and favoring the best plan for

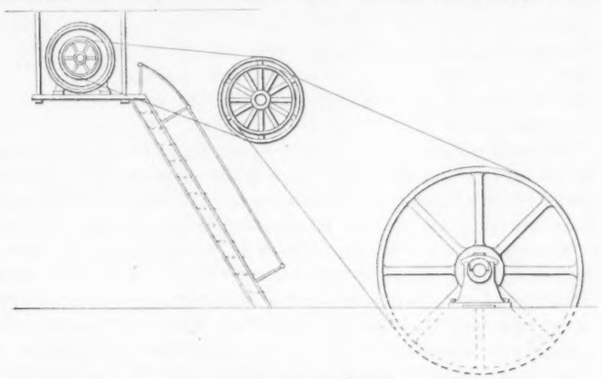


FIG. 1.—DYNAMO ON ELEVATED PLATFORM.

installing the same. The other is to take no interest in the subject, and then after the machine is installed, growl and find fault because he was not consulted in regard to what ought to be done, and the best way to secure the desired results. Choosing to adopt the former, I secured the kind of a machine that I wanted, it was installed in the place that I favored, and my plan for the details was adopted. This part of the subject is important, as it frequently makes all of the difference between a contented and a dissatisfied engineer. As the machine has always been ready for service when wanted, and numerous small failures in the lighting system have been repaired without serious trouble, expense or interruption to the service, it seems as if a few suggestions prompted by this experience ought to be valuable to other engineers of small steam plants in which dynamos are in use or may be installed in the near future.

In such a case the engineer feels alarmed if he is not familiar with electricity, because he may not be able to take care of the new machine and secure satisfactory results; hence he may be asked to resign in order that a more competent man may have the situation. As a general rule, to which there may be a few exceptions, this apprehension is unnecessary, because a man who knows enough intelligently to care for a steam plant, can easily learn how to operate an electric lighting system in connection with it. People who are either directly or indirectly interested in the sale of electrical machinery, sometimes claim that it requires no more intelligence to operate a dynamo than it does to run a grindstone. This is evidently a mistake, as the man who has run a grindstone for a long time and is then obliged to take care of a dynamo, will soon discover. Such statements are harmful, because they give too low an estimate of the service required; hence, if believed, they prevent an engineer from taking precautions to understand thoroughly the new duties and requirements, and such a course is a sure way to invite trouble and unsatisfactory results.

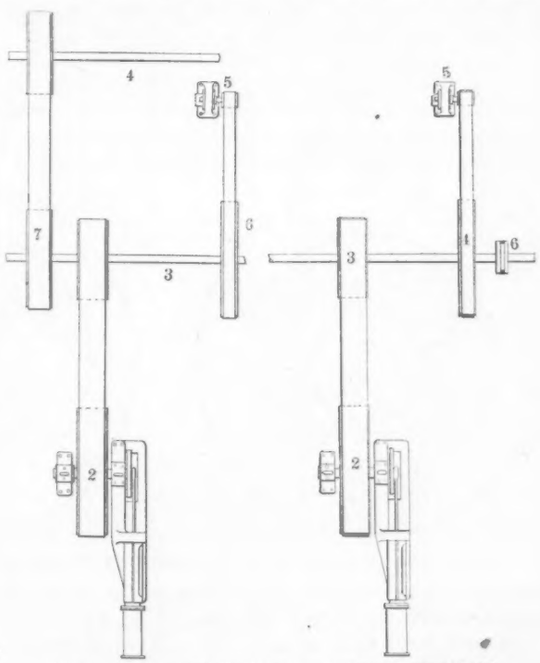
A compound-wound, four or six-pole dynamo will give satisfaction under average conditions, and is as good as any other kind for peculiar situations. When deciding on the place to locate such a machine, the coolest spot available should be selected. Where space is limited a dynamo is sometimes located on an elevated platform. (See Fig. 1.) Of course, it utilizes space that probably would not be used for other purposes, but heat rises and this fact makes such a location unsuitable unless it is ventilated much better than the average engine room.

It is assumed that this is a belted dynamo driven at a speed of about 1,000 revolutions per minute. A clutch pulley should be provided to drive it, so that it may be stopped at pleasure, and this pulley should be kept in good working order at all times. If it is thrown in and out frequently it will become loose in a few months, and, consequently, on some cloudy day when all of the lights are needed, it will slip and fail to carry the load. A clutch gives warning of this, but it is not always noticed by the engineer in time to save complete failure. When a clutch is properly adjusted, the lever goes in hard, but as time passes and the rubbing parts wear slightly, it goes in easier; the difference should be carefully noted and another adjustment made before it gets too loose to carry the load.

When plans are being made and considered for installing a dynamo, it often appears as if it might be driven by an ordinary pulley on a shaft that must always revolve when the engine is running; while this is possible it is not practicable, and hence is unworthy of adoption. If a clutch pulley is not adopted, then use a countershaft with a tight and loose pulley, but do not fail to provide some device for stopping the dynamo while the shafting is running. Furthermore, it is a good idea to provide means for running the dynamo while the mill shafting is at rest, as it will prove very convenient to have good lights in case it becomes necessary to change shafting or pulleys, or when other work must be done at night for which the shafting is not wanted. Fig. 2 illustrates this idea, as it shows an engine, 2, driving a jack shaft, 3, from which power is transmitted to the main shafting, 4.

The dynamo, 5, is driven from the jack shaft, 3, by a clutch pulley, 6, and therefore can be stopped at pleasure. When lights are wanted, and the shafting is not needed, 6 is kept in, but 7 is also a clutch pulley, and can be thrown out.

In some shops and mills there is no jack shaft, as the main belt transmits power direct to the shafting. This is illustrated in Fig. 3 in which 2 is the flywheel, 3 the main pulley, 4 a clutch pulley driving the dynamo 5; 6 is a cut-off coupling, and



FIGS. 2 AND 3.—METHODS OF BELTING DYNAMOS.

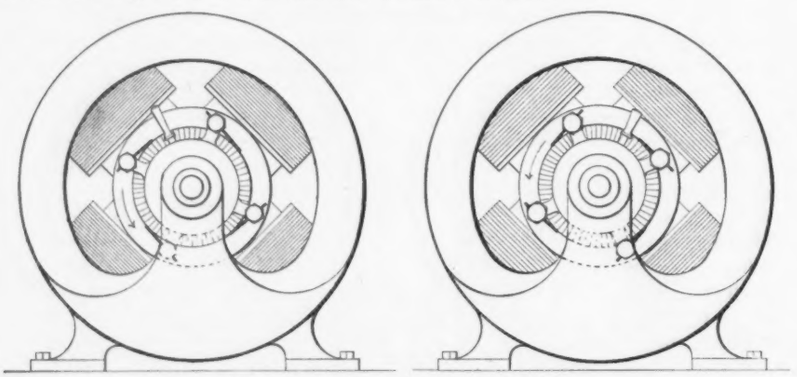
therefore the shafting beyond this point can be stopped at any time while the dynamo is still in use.

When the dynamo mentioned in the beginning of this article was delivered at my engine room I found that it was intended to run in the opposite direction from which it must revolve in this place. Fig. 4 shows how the carbon brushes were set, and the arrow indicates the direction of rotation. It could be used in this way with carbon brushes, but copper brushes would be ruined at once if an attempt was made to turn the commutator in this direction. However, it would never look right, and hence the brushes were reversed, as shown in Fig. 5.

Before making an attempt to change brushes in this way, the engineer should note that each one bears on the commutator nearly opposite the center of a field coil; therefore, when they are reversed the combined brush holders should be turned by a handle provided for that purpose until each brush bears on nearly the same place as before. This is shown in Figs. 4 and 5. It is not proper to set them exactly in their former positions, but if put opposite the center of each field coil it will be near enough for trial, and the proper position can be determined by experiment after the dynamo has been installed and while running at full speed as follows: Suppose that 114 volts are wanted at the switchboard in order to secure 110 at the lamps, but the pointer indicates only 75, with the rheostat in the position shown in Fig. 6. Turning the indicator from right to left causes the voltage to rise, but it may have to be turned as far as it will go in order to secure 114 volts. This is not satisfactory, because under ordinary working conditions it ought not to be turned more than one-half way around, thus giving an opportunity to adjust it in either direction if necessary.

The above mentioned result shows that the brushes are not in the right place, and therefore they must be turned until the voltage is brought up. The direction in which they must go can be determined by experiment, and it will do no harm to turn them in the wrong direction by mistake, as it will only reduce the voltage. In a certain plant that I visited, the engineer cannot reduce his voltage below 114 under common working conditions, even with the rheostat turned in as far as it will go. This is not a good plan, for if the engine speed should be accidentally increased, it might increase the voltage to a damaging point. Of course the same thing would happen if the speed was suddenly increased while the rheostat is in the central position, provided the engineer was not there instantly to turn it down. As this has happened twice in my plant, on account of an engine that does not regulate closely under quick changes of load, and as the same conditions are sometimes found elsewhere, this is an important point.

If the carbon brushes are left square they form but slight contact with the commutator. This will do no harm provided it can be run with only a few lamps on for several hours, until the natural wear gives better contact between the two surfaces. If this is not practical it is a good idea to take a strip of sandpaper, as wide as the brush, put it between the brush and the commutator with the smooth side next to the latter and draw it back and forth until enough of the brush is removed to make a good fit.



FIGS. 4 AND 5.—LOCATION OF BRUSHES.

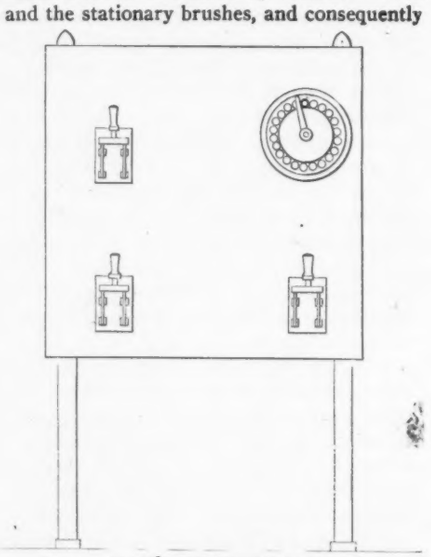


FIG. 6.—SWITCHBOARD.

An effort should be made to arrange matters so that the new dynamo may be run with a light load for at least two or three days, and care should be taken to know that the bearings are well lubricated during this time; for if they are not perfectly smooth when first used they may heat, and if not given an abundance of oil at this time the babbitting may be disturbed sufficiently to cause trouble afterward by always running warm. This is not only annoying, but is also dangerous because the armature should never become warmer than 90 deg. F. (50 deg. C.) above the temperature of the room, and cool bearings assist in keeping the armature temperature down. Furthermore, when such bearings really begin to heat they quickly reach the melting point; hence, if the outer parts are comparatively cool in regular service, it gives the engineer a better chance to discover the cause of trouble and provide a remedy than if the bearing was always warm and must only become a few degrees warmer in order to melt the babbitting.

After a dynamo has run cool for a month or more it is only natural for the engineer to expect it to continue to do so, especially if it is fitted with oil reservoirs and ring oilers. These are excellent devices, which save much trouble and care, but they should not be neglected. It does not take long to remove a brass plug or lift a cast iron cap to ascertain if there is oil in a reservoir, or if the ring oiler is revolving properly, but failure to do it has caused more than one hot box. I have known a reservoir to remain nearly full of oil for six months, then to become nearly empty without apparent cause. In view of this it is plain that safety lies in daily inspection of these parts.

When a dynamo is overloaded, or in other words, when more load is put on than the machine was designed for, it will cause the brushes and armature to heat, and after a reasonable time this heat will be transmitted to the frame.

If an overload is the real cause of trouble it can be determined by comparing the ammeter readings with the rated capacity of the dynamo. For illustration, I have a 15-kw belted dynamo to which there are nearly 400 incandescent lamps connected; and as each one requires about one-half ampere, it would require about 200 amperes to carry them all. Since this machine is good for 15,000 watts, and by dividing this by the voltage, or 112, we find the amperes to be 134. The actual load is frequently 140 amperes and it has risen to 150 for two hours or more without serious trouble, but if more than this is put on, one switch is pulled out to prevent damage to the dynamo.

When the brushes and frame begin to heat, the engineer may conclude that too much friction is caused by contact of the revolving armature and the stationary brushes, and consequently he proceeds to lubricate the commutator. This, however, is not always necessary, and sometimes it is harmful. A poor grade of oil is occasionally applied by means of a piece of waste, but it is useless, and the burnt sediment left behind it is detrimental to good service. A piece of the waste may be caught on the commutator and carried under the brushes, thus making it necessary to stop the dynamo and remove the cause of trouble.

Only a little lubrication is ever necessary at this point, and some of the lubricants prepared and sold for this purpose should be sparingly used, if anything is really needed. Keep the commutator bright and clean, and little else will be required. Use a medium grade of sandpaper for this purpose (never emery cloth), and always put it on the inside of a block of wood that is fitted to the curve of the commutator.

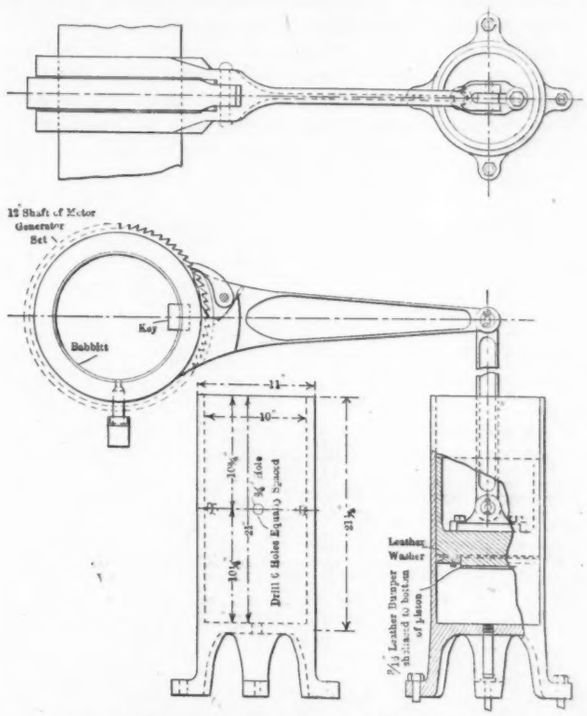
After the brushes have been used a long time they will be

worn down so that each one will cover two bars in the commutator. It is a good idea to take them out and file them until the point of contact is not more than one-eighth inch wide.

Use a pair of small hand bellows to blow dust out of the coils of wire, and keep the remainder wiped clean with good waste. Provision is usually made for moving a dynamo forward to take up slackness of the belt, which may therefore be made endless, requiring no laced joint. This is important, because the lamps will show variation of energy every time that a laced joint passes over the dynamo pulley. After shutting down at night, loosen the belt to give it a chance to relax.

Jack for Starting Motor-Generators.

The Edison Illuminating Company of Detroit has a direct-current sub-station located in a factory district in the northern part of the city, which district is somewhat isolated from the company's direct-current network. The starting of a 1500-kw motor-generator set recently installed in this sub-station would require, under ordinary conditions, such a large volume of current to overcome the initial friction of the bearings as to interfere seriously with the voltage regulation, and overload the machinery already running because of the small capacity of the other apparatus in the sub-station and the insufficiency of the feeders connecting this network with the principal direct-current district. The motor-generator set receives 4600-volt,



PNEUMATIC JACK FOR STARTING MOTOR-GENERATOR.

three-phase, 60-cycle current from the principal power plant at Delray and gives 110 and 220-volt direct current. The starting is accomplished by direct-current with a rheostat in series with the direct-current armature. To help in starting this motor-generator a pneumatic jack was designed, the construction and general principle of which are shown herewith. It consists of an air cylinder with a piston connected to an arm, this arm having a pawl engaging a ratchet on the armature shaft. The idea is to have this jack give the armature a single impulse or kick to overcome the standing bearing friction, which is considerably higher than the running friction of any plain bearing, and also to overcome some of the inertia of the rotating parts. It is found by the use of this device that the machine can be started with a maximum current of 500 or 600 amperes, as against 1500 amperes when it is started in the usual manner from standstill.

Wiring a Room Having Walls of Panel Work.

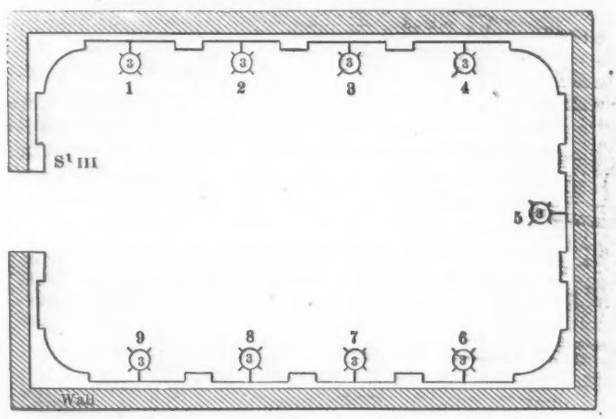
BY T. W. POPPE.

Often after a room is wainscoted, the owner desires to place incandescent electric lamps in the center of different panels. It is imperative that no damage be done to the wood or finish, and as the panels are often fastened with glue, it is next to impossible to remove them without injuring them to a certain extent. The marks made with the tools will readily be seen and are objectionable. It is therefore a problem to the wireman in charge how to do the work satisfactorily. The following explains how a paneled room was wired in a perfectly satisfactory manner.

A wainscoted room was oblong in shape and had four large panels on each side and two small panels and one large panel on one end; the door taking the place of the large panel on the other end of the room. A plan of the room is shown herewith. The panel frames were fastened to furring which caused the frame to set away from the wall seven-eighths of an inch. This is done in nearly every case, as it forms an air chamber between the panels and wall protecting the wood from moisture and also preventing dry-rot.

As the owner desired the lamps to be controlled by switches near the door an oblong opening, large enough to accommodate a three-gang switch-box, was made in the panel work near the door jamb. One switch was to control four three-lamp brackets on one side of the room; another was to control the four three-lamp brackets on the opposite side of the room, and the remaining switch was to control a three-lamp bracket on the end of the room opposite the door.

After cutting the opening mentioned, nine circular holes were drilled in the panels where the brackets were to be located. These holes were made five inches in diameter. A stiff steel "snake" was then pushed from the switchbox outlet behind the panels toward the corner of the room, and from the



PLAN VIEW OF ROOM, SHOWING LOCATION OF OUTLETS.

nearest opening on the adjoining side wall was pushed another snake. It was necessary to "fish" with the second snake. To achieve this result it was found necessary to fasten to the first snake sufficient strong cord to form several loops and to form a small hook on the end of the other snake. This hook readily caught in one of the cord loops on the end of the first snake and the latter was pulled out at the first bracket outlet opening. To this snake was then attached a sash cord which was pulled out at the switch-box opening. Here a two-wire steel-armored cable was attached to the cord and another sash cord. The two were then pulled out at the bracket outlet, "humoring" them as they made the turn at the corner of the room. Humoring consists of gently pulling at the cord and pushing the armored cable at the same time so as not to disconnect the "pulling" sash cord from the cable by too strong a pull. When the armored cable was pulled out at the bracket opening a sash

cord was connected to the one drawn in with the cable as was another armored cable. These were drawn to the switch-box opening. Then the sash cord already in was attached to a third armored cable and drawn to the bracket outlet. The purpose of drawing in the extra sash cord each time was to avoid excessive fishing.

The process was continued to the fourth outlet where one armored cable was dropped. The second cable was continued to the fifth opening, and the third cable was continued to the last opening. When the armored cables were all drawn in the outlet boxes were set and fastened to the brick-work behind the panels with expansion screws. The switch-box was likewise fastened with expansion screws. Six or eight inches of the steel armor of the cable was removed and the regular connector and outlet bushing applied. The wires should be tested with a magneto or bell and battery for continuity. If this is not done a defect which will cause some trouble to remedy afterwards may escape detection.

As the boxes did not fill the space at the bracket outlet, a "mat" one-quarter of an inch thick was colored the same as the woodwork and glued to the panel. This mat was made of veneer. It was circular in form, slightly larger than the opening and had holes for the passage of the wires and the supporting end of the bracket. The mat for the switch-box was made oblong and had an oblong opening large enough to accommodate the three switches.

Wiring for Direct-Current and Alternating-Current Motors.

By Louis J. Auerbacher.

The installation of electric motors is an important and profitable branch of the contractor's business, and if the number of orders is sufficient, the installation work should be in charge of a special and competent foreman.

Direct-current motors for ordinary work, are either shunt-wound or compound-wound. For regular work the shunt-wound motor is usually furnished, and it has installed with it an automatic-release, starting box.

Motors should be installed in dry locations, and not in dirty or dusty places or near inflammable gases. If location in a dusty place is unavoidable, the motor should be housed in a dust-proof sheathing, or an enclosed type of motor should be used. Enclosed motors, owing to the temperature rise due to lack of ventilation, have a lower rating, size for size, than regular motors.

In some localities motors are required to be mounted on drip pans, as illustrated in Fig. 1. Sliding rails are used in connection with belted motors, so as to take up the slack of the belt.

A good plan is to fasten motors on the ceiiing. This method saves considerable floor space and eliminates the danger of the running belt. To hoist the motor in position, remove the flooring directly over the place where the motor is to hang, and mount the tackle on the ceiling of the next floor or on a support. The motor can then be easily aligned and bolted in position. In mounting a motor on the ceiling, the bearings must be turned so as to bring the oil cups in their proper position.

The automatic or no-voltage release starter must be mounted on a slate or marble backing, and the form of the starter should be such as to allow of the fullest air circulation on all sides. A good plan is to mount the switch with its fuses and circuit breaker on the same panel with the starter. Such panels are on the market and are neat as well as substantial.

Wiring to motors should preferably be run in iron conduits, especially where motors are located on floors, but other approved methods of wiring answer as well if properly installed. Fig. 2 illustrates a conduit wiring scheme using terminal fittings which spread the wires.

If motors are to be used to run elevators, in connection with automatic or solenoid starters, or if they are required to start under a load, a compound-wound motor should be installed.

To change the direction of rotation of a shunt-wound motor reverse the brushes and interchange the field leads as shown in Fig. 3. The direction of rotation of compound-wound motors may be reversed in a similar manner.

Motor connections should be carefully made and tested before the machine is switched into the circuit, as a motor is very easily damaged by starting under improper conditions. It is

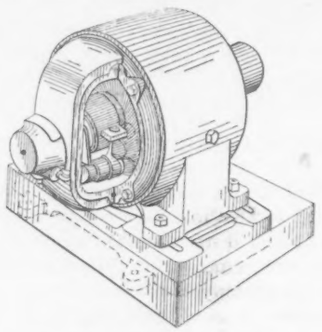


FIG. 1.—MOTOR EQUIPPED WITH DRIP PAN.

of primary importance that the resistance is in series with the armature circuit. This is necessary to prevent excessive current in the armature, which has a low resistance and would consequently be destroyed. As soon as the armature is speeded up the counter e. m. f. generated increases, and the resultant e. m. f. produces a less current in the armature circuit.

The no-voltage or automatic release on the starting box is a very important adjunct. Without it, should the circuit be momentarily interrupted and then closed again, the excessive current through the armature, starting with no resistance in circuit, would either burn out the armature or blow the fuses.

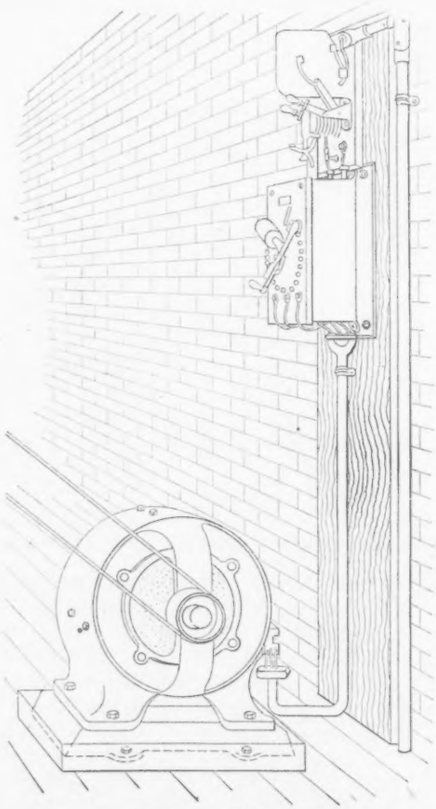


FIG. 2.—APPROVED WIRING OF MOTOR.

In wiring motors in connection with automatic starting devices the diagrams and instructions furnished by the manufacturer should be followed. The ordinary wireman frequently makes errors, especially in making connections from diagrams. A good plan is to tag the motor terminals and special device

terminals in the following manner: A to A-1, B to B-1, etc., putting proper tags on each terminal.

For varying the speed of motors many methods are used. In connection with some motors a resistor is used with considerable resistance in the main circuit. Another plan is to insert

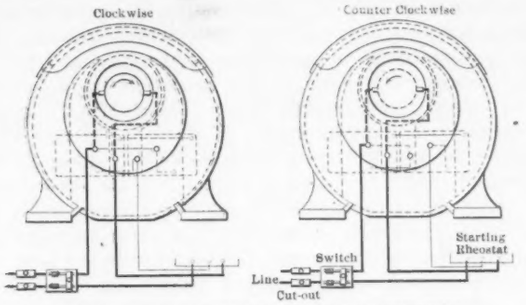


FIG. 3.—SHUNT-WOUND MOTOR CONNECTIONS.

a resistor of variable resistance in the field circuit, whence by varying the strength of the field the speed is naturally changed. There is a great variety of special variable-speed motors on the market. In wiring these motors in circuit the diagrams and instruction blanks furnished by the builder should be carefully followed.

As the current initially taken by a motor is considerably greater in value than the normal running current, the fuses or

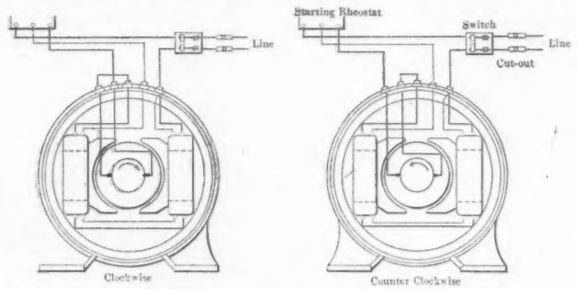


FIG. 4.—COMPOUND-WOUND MOTOR CONNECTIONS.

other safety devices, such as a circuit-breaker, should be sufficiently large to take care of this initial rush. Table I gives the rating of various motors, showing their normal full-load current and the rated capacity of fuses to use.

Circuit breakers are sometimes used in place of a switch and fuses, and though the initial cost is greater, their use, where

TABLE I.—FUSES REQUIRED FOR VARIOUS MOTORS.

Horse-Power of Motor	Full Load Current at 115 Volts	Ampere Rating of Fuses Required	Full Load Current at 230 Volts	Ampere Rating of Fuses Required	Full Load Current at 550 Volts	Ampere Rating of Fuses Required
2	16	25	8	20	3½	10
3	24	35	12	25	5	15
5	39	60	19	40	8	20
7½	57	75	28	50	12	25
10	75	100	37	60	15½	30
15	113	150	55	75	23	35
20	151	175	74	100	31	40
25	188	225	92	125	38	50
30	226	275	111	150	46	60
40	300	350	148	175	62	80
50	374	450	185	225	75	100

permitted, is cheaper in the end, as there are no renewals required as when fuses are used. The code requirements, however, call for fuses in connection with circuit breakers, except on main switchboards.

In selecting a direct-current motor for a customer consideration for future requirements should be taken into account. If belted or geared to a fixed load, the motor should be the nearest standard size relative to the load. A standard motor operates at its maximum efficiency at or near full load, and the efficiency is reduced when operating under partial load. If the motor is belted to a line of shafting driving a number of machines, the average load should be taken, plus a reasonable allowance for additions.

Motors geared direct to machinery make an ideal drive. Geared motors should be run at as low a speed as possible. Motors of a certain horse-power rating may be obtained with two or three speeds. The motor having the lowest speed should be used for geared work. The pinion on the motor should be made of rawhide, so as to minimize the noise and wear on the gearing. A silent chain-drive may also be used to advantage with geared motors. In calculating the size of gears required for various speeds, the same formulas apply to the silent chain-drive as to gears.

$$\frac{\text{number of teeth} \times \text{speed of gear}}{\text{number of teeth in pinion}} = \text{speed of pinion.}$$

$$\frac{\text{number of teeth} \times \text{speed of pinion}}{\text{number of teeth in gear}} = \text{speed of gears.}$$

$$\frac{\text{number of teeth} \times \text{speed of gear}}{\text{speed of pinion}} = \text{number of teeth in pinion.}$$

$$\frac{\text{number of teeth} \times \text{speed of pinion}}{\text{speed of gear}} = \text{number of teeth in gear.}$$

The following formulas may be used for determining the size of pulleys required for various speeds:

$$\frac{\text{diameter} \times \text{speed of driven pulley}}{\text{speed of driver}} = \text{diameter of driver.}$$

$$\frac{\text{diameter} \times \text{speed of driving pulley}}{\text{speed of driven pulley}} = \text{diameter of driven pulley.}$$

$$\frac{\text{diameter of driver} \times \text{speed}}{\text{diameter of driven pulley}} = \text{speed of driven pulley.}$$

It is a good plan to install devices for stopping the motor from a number of distant points in a factory. Such a device will often prevent a serious accident when an employee is caught in belting or gearing. Numerous commercial devices fitted with push-button control are manufactured for this purpose. Fig. 5 illustrates a home-made device which has been found to be reliable, as well as inexpensive. It can readily be assembled by any carpenter. An ordinary electric door opener is mounted as shown, in connection with a knife-switch of proper size. A weight sliding on a rod, and having a trigger, is released when the magnet of the door opener is energized. This weight in falling strikes the switch handle and consequently opens the circuit. Any number of push buttons connected in multiple can be used to operate this device. Two or three ordinary dry cells are used to operate the door-opener circuit. Fig. 6 illustrates a good type of circuit closer for emergency use.

Automatic solenoid starters are used when motors are to be started or stopped automatically or from a distance. One of the most frequently used applications of this type of starter is in connection with belt-driven elevators. Fig. 7 shows a type of starter suitable for such use. A "belt switch" is required to close the solenoid circuit. This belt switch is connected as indicated and the outfit makes a very satisfactory installation.

The alternating-current motors on the market may be divided into two classes, single-phase and polyphase. Single-phase motors are of the induction and series types, and the polyphase motors are of the induction and synchronous types. Polyphase motors include both two-phase and three-phase machines. Motors of the induction type are provided with auto-starters or with variable secondary resistance for starting. Synchronous motors are sometimes made self-starting, but more often they are provided with an induction motor for bringing them up to speed or are brought up to speed from some other source of motion through a clutch or belt. A compensator starter may also be used.

Single-phase motors are regularly made up to 15 horse-power and in providing fuses and circuit breaker, the size of the fuses

should be such as to take care of the initial current, which is about twice the normal full-load current. In starting the single-phase motor, the double-throw switch on the starter is first thrown to the starting position, and after the motor has attained full speed, the switch is thrown to the running position.

On two-phase and three-phase circuits, induction motors are usually used. For large installations where 50 or more horse-power is required, synchronous motors are frequently used, as they diminish line disturbance and voltage fluctuations. The contractor seldom is required to install the synchronous motor, and if called on to connect up such a motor he should follow the manufacturer's instructions and diagrams.

The induction motor when required to operate at a constant speed in a given direction has many advantages over the direct-current motor. Its disadvantages are that the speed controller and reversing apparatus required for special work is complicated and expensive.

Induction motors of the squirrel-cage type are very simple and reliable, and have no commutators or brushes. An overload will tend to reduce the speed of the motor when it may drop out of step and stop.

In calculating the size of a motor to perform certain work, it is advisable to overload the induction motor slightly, instead of underloading it. An induction motor runs with a higher power-factor at a small overload, whereas the power-factor on underload is very low.

In deciding what type of induction motor to use, the conditions under which the motor is required to operate must be carefully considered.

Where motors are used in connection with a single machine and are frequently started and stopped, the auto-starter type will be found the most serviceable. This is due to the fact that even should the operator carelessly start the motor by throwing the switch over to the running position without going through the intermediate steps, no damage to the apparatus will result. Such procedure, however, should be rigorously discouraged.

In installations where the motor is started and stopped only once or twice a day by a careful attendant, the type of motor with an internal starting resistance should be used. This type of motor draws less starting current than the other type, and for that reason some electric light companies insist on an induction motor with self-contained resistance being used. The induction auto-starter motor frequently requires four to five times the normal running current at starting. Table II gives the starting and full-load current of three-phase induction motors.

The enormous difference which exists between the size of wires would satisfactorily and safely carry current for operating an induction motor, and the size of wires which would be required by a strict and narrow interpretation of the Code has been the cause of bitter argument many times between electrical inspectors and contractors. A wire of such size as to be protected properly by the large fuses required in starting is an unnecessary expense, and a fuse large enough to permit the motor to be started is no protection to the motor after it is running, as it would not blow on anything less than a short-circuit. It is customary, therefore, to provide two sets of fuses for induction motors requiring excessive current in starting; those on the starting side being larger than those on the running side of the switching circuit. In this way it is possible to start the induction motor without blowing the fuses, and after the motor

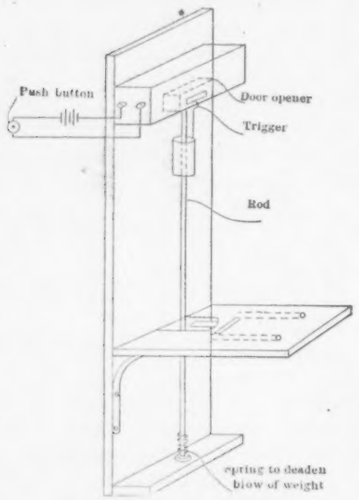


FIG. 5.—EMERGENCY STOP.

FIG. 6.

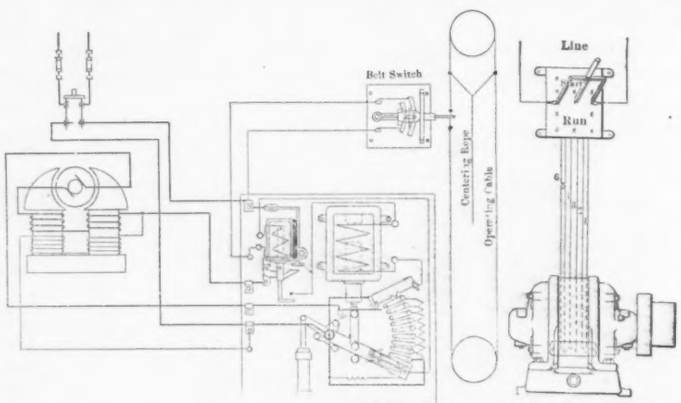


FIG. 7.—BELT SWITCH AND CONTROLLER.

FIG. 8.—SINGLE-PHASE MOTOR.

TABLE II.—CURRENT TAKEN BY THREE-PHASE INDUCTION MOTORS AT 110 VOLTS.†

Horse-Power of Motor	Full Load Current	Starting Current at 150 Per Cent of Full Load Torque	Starting Current at Full Load Torque
1	6.3	19	
2	12	36	
3	18	54	
5	28	42*	28
10	54	70*	54
15	81	120*	81
20	112	167*	112
30	168	252*	168
50	268	400*	268
75	390	585*	390
100	550	825*	550

* Equipped with auto-starters.
† On 220-volt circuits the current is approximately one-half of that given in the table.

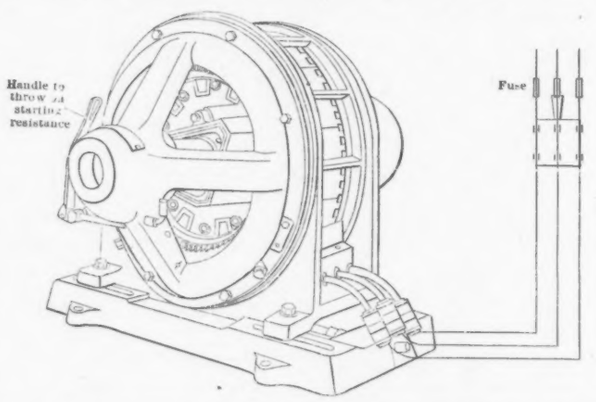


FIG. 9.—THREE-PHASE MOTOR WITH INTERNAL STARTING RESISTANCE.

is running it is properly protected by the smaller fuses. Oftentimes conditions of operation are such that the time element of the fuses is sufficient to permit the motor to be started with smaller fuses, especially if the motor comes up to speed quickly. Motors taking less than full-load current when starting need only the running fuses.

Nearly all of the manufacturers of alternating-current motors supply starting devices also, together with complete instructions

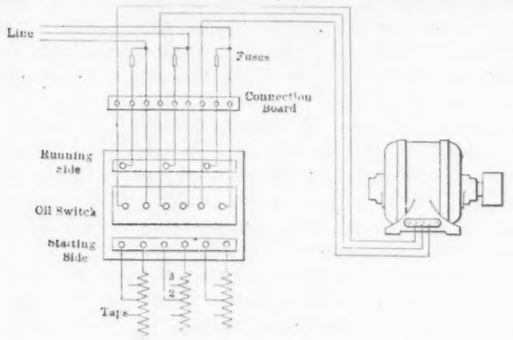


FIG. 10.—THREE-PHASE MOTOR WITH STARTING COMPENSATOR.

for connecting them in circuit. In motors rated less than 5 horse-power no auto-starters are required; the knife switch connects the motor directly with the line.

In wiring two-phase motors, three wires, as well as four wires, are used. If three wires are used, the third conductor should have approximately one and one-half times the sectional area of either of the other two. In four-wire, two-phase systems motors of one horse-power and under are usually of the single-phase type, and these are connected across one of the two phases of the system.

Notes on Superheated Steam Fittings from the Detroit Edison Company's Practice.

The Delray plant of the Detroit Edison Company has now been in operation about three years. As this is a steam-turbine plant operating with steam superheated 200 deg. at 210 lbs. boiler pressure, some notes on the experiences with steam fittings in this station are of interest.

It is found that cast-iron pipe fittings develop some remarkable tendencies under high temperatures and pressures. Cast iron seems to "grow" under such pressures. For example, a 36-in. cast-iron fitting has been known to increase in length ¼ in. on one side more than on the other. In other words, it positively warped. Bonnets and valve chests also warp and develop star cracks. These troubles took from one to two years to develop. It was not realized what the trouble was at first when cast iron fittings were taken out of a pipe line and could not be replaced without a great deal of trouble. Finally it was found out by measurement that they had warped. As a result of these experiences, cast fittings are made symmetrical whenever possible, as an unsymmetrical fitting is much more likely to warp. Experiments are being made with valves of reduced area, in order to reduce the size of fittings. This will partially reduce warping tendencies. Cast steel and welded parts are being substituted for cast iron wherever possible.

Boilers have been connected to headers by means of 30-ft. bends of 8-in. pipe. The boilers are rated at 520 horse-power each. It has been found that for steam-turbine practice where there is a steady flow of steam, a 5-in. pipe is sufficient to carry the steam from a 520-hp boiler; and by making these bends of 5-in. pipe, it is much easier to connect and disconnect them from the pipe line, on account of the greater flexibility of a 5-in. as compared with an 8-in. pipe. The gaskets used are of very thin copper.

The station, as originally piped and described in the ELECTRICAL WORLD, Feb. 4 and 11, 1905, had provision for flooding the superheaters with which each Stirling boiler is equipped so that the turbines could be operated with saturated steam. This provision has been found unnecessary, as there are practically no conditions where saturated steam is wanted for the turbines. Saturated steam is, of course, used for the auxiliaries, and on the boilers supplying the auxiliaries a separate connection is made for this.

No trouble has been experienced with rubbing of turbine blades during the rapid expansion of parts when a turbine is started suddenly. These Curtis turbines, which are rated at 3000 kilowatts, can be started from rest in 90 seconds. Practically the only thing that limits the rapidity with which a turbine may be put into service is the time required to start the auxiliaries.

The five 3000-kw turbo-generators in the Delray plant being now fully loaded, a second plant has been started adjoining the first. The second plant will have 8000-kw turbine units.

Steam Auxiliary to Hydro-Electric Station.

BY WM. LEE CHURCH.

The subject of steam auxiliary to a hydro-electric plant needs representation in a somewhat different light from that in which it is generally understood. Hitherto a steam auxiliary has largely been considered a necessary evil, seldom having a part in the original scheme of development and usually installed in a more or less make-shift fashion when pressing necessity requires. When a hydro-electric proposition is presented to financial interests about the first question is: "How much power is this river good for?" "Well, it is good for a minimum of 20,000 horse-power." "Do you mean that this is the absolute minimum in the lowest flow of the dryest recorded year?" "Probably not—in the extreme low water of an occasional year you might require 5000 horse-power of steam aux"—— Up go the hands in horror and the deal is off. "We want a water-power plant, we don't want a steam-power plant!"

Now, all this is very natural. Like most engineering evolution, the idea of an auxiliary steam plant as a thing to be avoided took its origin in supposed and seemingly obvious facts. Experience, however, on the commercial side of propositions of this character has slowly let in a dawning light on the situation. Engineers and investors have begun to investigate the actual conditions of the problems by balancing cost, operation, maintenance, etc., against increased revenue. It is for the purpose of bringing out this by no means new, but, at the same time, somewhat cloudy view, that this article is written.

For the sake of more convincing illustration consider an actual case that has come within the writer's practice. A study of the recorded flow of a certain river indicated that it would produce 10,000 to 12,000 horse-power even in the extreme low-water years. The market demand, however, was such that 20,000 horse-power could be utilized if it could be continuously guaranteed. The 10,000 horse-power could not be absolutely guaranteed for every day of every year, but the shortage was so slight and so infrequent that a 10,000-hp development was perfectly justifiable, and with the storage value of the lake itself it was even possible to expect 12,000 horse-power. The class of users for this power was such that occasional slight shortages at rare intervals would be condoned, but the market which demanded the maximum of 20,000 horse-power was of such a nature that no shortage whatever at any time could be considered.

To get at this problem recourse was had to the available data from six years of government records, namely, from 1901 to 1906, inclusive. 1901 was a wet year and the natural flow of the river on the lowest day would have yielded 24,000 horse-power; 1906 was almost a duplicate, the minimum flow being 23,000 horse-power. (In all cases the power is considered as 24-hour continuous power.) The years 1902 to 1905, inclusive, were quite variable in rainfall, and fortunately included the year 1904, which was the dryest year on record for that entire section of the country.

Taking the year 1902, the flow was computed in terms of horse-power and tabulated. It was found that there were three

days in that period in which the flow ran down to 6900 horse-power; 20 days to 8350 horse-power; 30 days to exactly 10,000 horse-power; 34 days to 12,000 horse-power; 27 days to 14,000 horse-power; 18 days to 16,250 horse-power; 16 days to 18,650 horse-power, a total of 148 days of varying shortage on the 20,000 horse-power basis. There was no considerable storage, so that these various shortages have been grouped together and the resulting "curve" plotted to scale as the zigzag dotted line shown in the accompanying illustration. Now, right here is where somebody will say: "Why, there you are, running 148 days, or nearly half your time, by steam!" Well, we shall see.

A similar study of 1903 gave somewhat better results, which are plotted in the broken line on the chart; 1904 was the extreme year and gave the heavy line; 1905 was a fairly good year that would have yielded 12,000 horse-power on the flow of the stream, and its shortage resulted in the light full line on the chart.

As a basis for this chart a rectangle was constructed of which the vertical ordinates represented power and the base represented time. The area, therefore, of the complete rectangle

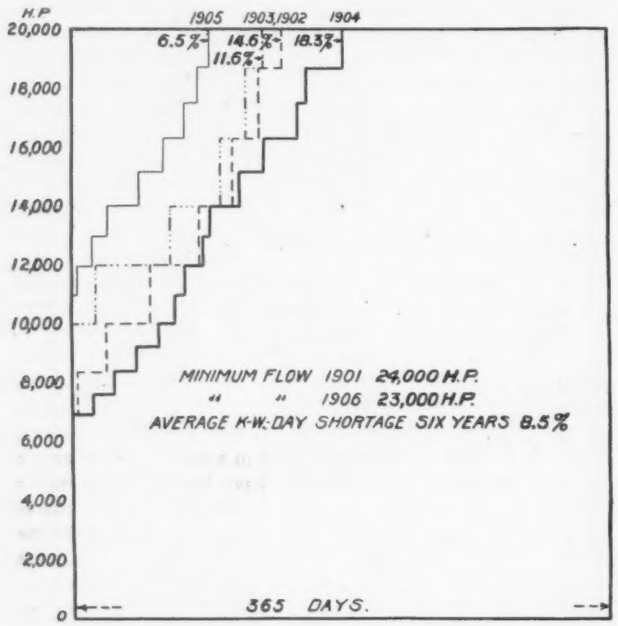


CHART SHOWING ENERGY SHORTAGE THROUGHOUT THE YEAR.

represented the energy demand, or 20,000 horse-power for 365 days, equal to 7,300,000 hp-days.

The point now to be observed is that the triangular areas in the corner of the diagram, bounded by the two sides of the rectangle and the zigzag line for each year, show the actual energy shortage in terms of hp-days.

Counting on the diagram the respective small squares included in these triangles gave the following results in percentages, obtained by dividing the hp-days of shortage by the total hp-days representing total energy, or full power for the total year:

1901		Surplus
1902	14.6	per cent shortage
1903	11.6	" "
1904	18.3	" "
1905	6.5	" "
1906		Surplus

Adding the shortages and dividing by the total hp-days for the six-pear period, the total shortage in hp-days for that whole period was 8.5 per cent. It is, therefore, apparent that without auxiliary resources of some sort this river was strictly an 8000 horse-power proposition, or on a commercial basis, say, 10,000 horse-power; whereas if 8.5 per cent of auxiliary energy can be added in some form the river immediately becomes a 20,000 horse-power proposition.

Stated concisely in terms of dollars, the securing of 8.5 per cent of reserve energy would double the income. (Of course, this surplus should be supplied, if possible, by reserve storage of water, but many rivers fail to yield sufficient storage space owing to their natural formation.)

Now the misapprehension in the past has been that the power rating of the steam plant in relation to the total power rating of the hydro-plant was the measure of the shortage, whereas the measure of the shortage is really the product of the varying steam load into the proportional time run; in other words, the energy percentage. The rating of the steam plant expressed in horse-power bears no relation whatever to the earning capacity of the development as a whole, except in so far as is represented by interest and depreciation on its cost—and, of course, its extra operating charge.

Turn again to the chart and note that had power rating been the true measure of relative value, the so-called shortage in the years 1903 and 1905 would have been practically 10,000 horse-power, and in the years 1902 and 1904 the shortage would have been 13,000 horse-power, scaling down from the top of the chart. The tendency hitherto has been to say, "This development is one-half to two-thirds steam and we don't want anything to do with it." I hope it has been shown that the true expression would be, "This development requires only 8 per cent of steam energy to double the income and, therefore, is worth looking into."

To turn the matter around once more, so as to get it in still another practical light, it appears that this development should have been equipped with about one-half its rating as a steam auxiliary. This would take care of the years 1903 and 1905, and with the usual margin allowable for overload, would have pulled through the lowest years of 1902 and 1904. The effect of this additional investment would be to double the gross income of the plant as a whole.

Now it is at once seen that good engineering would dictate the installation of a steam auxiliary not along the line of refined economy at all. Expensive boilers, economizers, compound engines and economy adjuncts generally should be rigorously excluded in such a plant. Some rugged form of engine capable of "standing grief" under overload would be the proper type. It might be single-expansion, while a condenser and a heater would be about the only allowable economy adjuncts. Just where this line should be drawn would only appear in the study of each individual case, but the governing principle is that inasmuch as the time of service in a period of years is so insignificant, the value of the coal saved by compounding, etc., must be balanced against interest and depreciation on the plant and the extra space required. It is the province of the engineer to determine this question closely in connection with each proposition and on its merits.

Having led up to this point, it becomes self-evident that so far from a steam auxiliary being a burden upon and a detriment to the commercial proposition, it may, instead, be the largest earning factor in it. The hydraulic development and the land are fixed items, and are usually one of the largest elements in the total cost of development. Now in this particular case this part of the investment would have yielded an income due to only 10,000 horse-power, whereas, aided by steam auxiliary, it would have yielded 20,000 horse-power. As a rough statement, and in other words, to develop only 10,000 horse-power the total investment would have been, say, $175 per horse-power. By adding the cost of a plain steam plant of the simplest character, the whole proposition is raised to 20,000 horse-power on an earning basis, and the investment cost is dropped to, say, $125 per horse-power.

This summation is really all there is to the subject. Proper consideration will lead, it is hoped, to a more careful investigation of every hydraulic development on the basis of its energy output value over a series of years, when aided by a steam auxiliary (storage assumed as unavailable), and in the light of the total investment per horse-power; and, second, to a more intelligent designing of the auxiliary steam plants, considered, not as a monument to the engineer, but as an investment, held rigidly down to those lines which will produce the largest net returns to the owners on the equipment as a whole.

LETTERS ON PRACTICAL SUBJECTS.

COMMERCIAL FEATURES OF SINGLE-PHASE INDUCTION MOTORS.

Single-phase induction motors are used in small sizes on the lines of every alternating-current system. The numerous small energy consumers, such as butchers, ice-cream makers, druggists, etc., want small motors rated at 5 horse-power or less, and due to reasons to be herein discussed, a single-phase induction machine is usually installed.

There are in general two types of single-phase induction motors in common use; that is, the machine which starts up from rest due to a phase-splitting coil, and the one which starts as a repulsion motor.

The split-phase starting motor is very satisfactory for operating individual sewing machines, buffing machinery, wood lathes, etc. This type of motor was the first and easiest solution to the problem of rendering a single-phase induction motor self-starting. The motor is a polyphase induction machine which is supplied with two currents differing in phase, which produce a starting torque. To apply this machine to loads which are hard to start, such as a loaded line shaft or other heavy starting load, another ingenious device was brought to bear. A pulley was designed which at standstill or low speeds is loose on the shaft, but under sufficiently high speeds is gripped to the shaft by a centrifugally operated clutch. This latter device enabled the motor to attain almost synchronous speed before the load was started, giving it work at or near the maximum of its torque characteristic. Thus fully prepared by "curative medicines," the machine was built and advocated by engineers because there seemed no better solution to the problem. To those men and engineers who understand the limitations of the machine and use it in the proper places, surprisingly satisfactory performance is attained.

The split-phase motor is on the market to-day in large numbers, and is supported by some of the best companies.

Other engineers were at work, however, at about the same time on the alternating-current motor of the repulsion type. The characteristics of the repulsion motor are practically the same as those of the direct-current series motor, so that a combination of repulsion motor for speeds from zero to synchronism or thereabouts, with a single-phase induction motor for normal near synchronous speed operation has proved advantageous. Thus, high starting torque is obtained together with small speed variation from full-load to no-load. The latter machine finds its peculiar field in driving water pumps, printing presses, machine tools of all types, and, while covering the entire field of small energy users, its operating characteristics are such as to adapt it especially to all classes of loads where high starting torque is necessary.

Operators of direct-current machinery are accustomed to believe that heavy overloads of from 50 to 100 per cent for short intervals are not to be feared. Single-phase machines will not meet the demands for overload outlined above, and it is customary to install motors of slightly larger rating when replacing direct-current motors with either of the above types of single-phase induction motors.

The small ability for overload possessed by the single-phase machine is not inherently due to the design nor to the special features necessary in producing a self-starting motor. Motors are usually rated and designed to give the maximum efficiency at full load. Moreover, the maximum power-factor occurs at approximately full load. An increase of load increases materially the internal copper losses of the machine due to the larger load current. The load losses are greater, due to lower speed, or greater slip, and, what is more vital, there is no longer a uniform rotating field, further decreasing the torque and output. The repulsion-starting single-phase machine has its limitations, however, for which allowance must be made. The addition of a commutator to an induction motor is not an ideal solution to the problem. A commutator immediately suggests troubles from sparking, brush setting and the need of close attention. This is the point which is attacked by engineers and central-station men, the point which, theoretically at least, lowers the value of the motor.

Practically, the manufacturers of the repulsion-starting motor place the commutator so as to discourage any attention, expert or mediocre, and with the result that the motors are operating satisfactorily in pump houses, grist mills and laundries with infrequent attention even from the oil can.

All single-phase induction motors have the advantage over direct-current machines in that they may be started by simply closing the switch. The rush of current at starting ranges from two to three times the full-load current with a torque at starting equal to the full-load torque. Here is where the repulsion-starting type has the advantage. At starting it can exert five times the full-load torque, and its torque characteristic closely resembles that of a direct-current cumulative compound motor. Since a starting device is unnecessary, these motors are practically "fool proof," and may be placed in the hands of any one who can throw a switch. The small energy user prefers such a machine. The central station man prefers the motor for this reason, and also for others; he can install one transformer to take care of it, thereby reducing the all-day iron losses, a less expensive meter, and much less extensive wiring than would be possible if a polyphase motor were supplied. It goes without saying that for a single-phase supply circuit these motors must be used. For installation of over 5 horse-power on polyphase lines, polyphase induction motors are installed. In some cases single-phase induction motors are allowed, and recommended when rheostats are used to limit the starting torque to 100 per cent of the full-load intake.

A flagrant case of misinformed salesman engineering came to the writer's notice during the past few months, which illustrates the troubles a man well acquainted with direct-current machinery may find on the alternating-current side. A direct-current 4-hp motor was successfully driving a small pump which required frequent starting and stopping. It became necessary to replace this machine with a single-phase motor. A representative of a well-known company recommended a certain single-phase motor, and took the order for a 4-hp machine. The motor duly arrived, was installed and shortly afterward burned out. A representative of a rival company guaranteed his motor to do the work and replaced the last machine with a new 4-hp motor. It required only a few hours to put the latter motor on the "burned-out list," and being guaranteed the salesman replaced it with a 5-hp motor of the same type; the latter lasted only slightly longer than either of the former motors. It is needless to point out that these machines were split-phase motors, and as such did not have sufficient starting torque to start the pump without drawing large current for a long time.

An engineer who recognized the differences between the various single-phase motors commended the use of a repulsion-starting type of motor. The central station manager in that town knows more about alternating-current motors now, but his experience was costly.

LINCOLN, NEB. V. L. HOLLISTER.

INSULATION BETWEEN COMMUTATOR BARS.

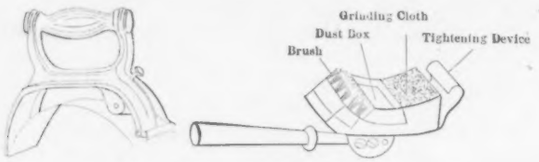
From time to time I have noticed requests for information on substances suitable for repairing the burnt insulation between commutator bars. The answers usually recommend powdered mica and some shellac or other insulating varnish as a binder. No doubt this mixture should give almost as good results as the original mica itself. I have never tried it, however, and hence cannot say how good the results might be. It may be interesting, however, to give the composition of another insulating compound that I have tried and which gave good results. The burned insulation between the commutator bars must first be dug out and the cavity thoroughly cleaned. Then a thin paste of litharge and glycerine is poured into the cavity. A soldering iron or a small blow torch should then be

used to heat the mixture until it is thoroughly baked. When the compound has hardened sufficiently it may be filed down smooth and even with the commutator surface. It might be well before applying the paste to test the bars to make certain that the short circuit has been removed. Holes plugged with this mixture have never given any trouble since.

Syracuse, N. Y. H. B. Baker.

THE CARE OF COMMUTATORS.

If maximum efficiency in the running of direct-current machinery is to be obtained with the minimum of expense, the maintenance of commutators and brushes must be given due consideration. It is no longer considered good policy to wait until there is a fine display of pyrotechnics before giving the commutator or brushes attention. It is also quite inconvenient to take out an armature from a motor or dynamo to send it



FIGS. 1 AND 2.—COMMUTATOR CLEANERS.

away for the purpose of turning down the commutator; and it is the purpose of the writer to describe some home-made and some commercial devices for keeping the commutator in condition and for repairing it without removing the armature shaft from its bearings. It is taken for granted that the brushes are in their proper position and they have been carefully fitted to the commutator by means of sandpaper in the usual manner. A good running commutator should present a dark, glossy appearance, free from scratches. Too much attention cannot be given to the commutator and brushes, and their proper or improper condition is an index of the competency or incompetency of the attendants. The habit of caring properly for a commutator is easily acquired by any careful man, and it is well to remember that prevention is much better than cure for troubles of this kind. The attendant should make certain that the armature oscillates in its bearings while running, as this will greatly lengthen the life of both the commutator and bearings. In large machines mechanical oscillators are sometimes provided for this purpose so as to prevent the brushes from wearing grooves in the commutator.

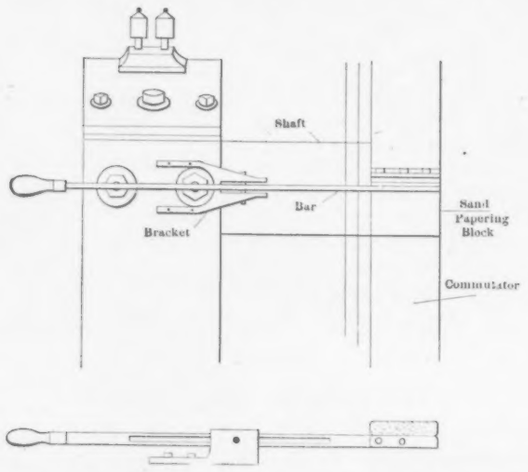


FIG. 3.—DEVICE FOR SANDPAPERING COMMUTATOR.

The commutator should be cleaned regularly with a cloth slightly moistened with light mineral oil. A touch of vaseline may also be applied from time to time for lubrication purposes. Where the commutator has become quite dirty or slightly roughened, it may be smoothed by using sandpaper. This may best be applied by means of some handy device. A useful tool may be made up of a piece of well-seasoned pine shaped to fit the commutator and provided with a handle. The sandpaper is fastened to the wood by tacking it to the ends, and should be bent up along the edge of the wood for this purpose.

Another useful device for this purpose is shown in Fig. 1 herewith. One end of the sandpaper or polishing cloth is inserted under the clip at the front end and the cloth is then turned back under the flexible backing and applied to the commutator. The flexible backing is made in such a manner that it easily adapts itself to the curve of the commutator, but will not fall into depressions on the surface. Thus, the whole surface is evenly scoured and afterwards polished.

A novel appliance for sandpapering a commutator which is designed to avoid the necessity of holding a piece of sandpaper against the commutator by hand, which is a very tiresome operation, is shown in Fig. 3. The device consists of a

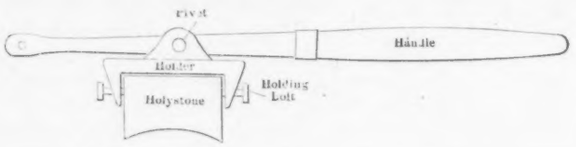


FIG. 4.—HOLYSTONE FOR COMMUTATOR.

bracket of wrought-iron 3/8 in. thick, held against the pillow block by four lag screws. Inside this bracket a long iron bar with forged lever and a slot running almost its entire length is held by means of a bolt. The sandpaper is fastened to a wooden block at the end of this bar. The method of holding the bar in the bracket keeps the sandpaper in a plane at right-angles to the diameter of the commutator so that the surface will always be flat. At the same time the pressure can be easily regulated by the handle.

Frequently a commutator which appears so rough as to require turning may be placed in satisfactory condition by stoning. A holystone can be placed in a holder of convenient shape and size as shown in Fig. 4, and one of the long surfaces made to fit the curvature of the commutator. The handle of this holder should be arranged so that the attendant who uses it can hold it with comfort and safety. A stone of this kind is preferable to sandpaper, as it will not dip into all the low places of the commutator and will usually reduce high bars and avoid the use of the turning tool. If the sandstone is rather coarse, it may be desirable in finishing the surface of the commutator, to line the rubbing surface of the stone with a sheet of fine sandpaper. The commutator may be given a buff finish by simply turning the sandpaper over. The use of a commutator turning tool will decrease the radial depth of the commutator appreciably, while the holystone will wear the commutator much less. The process of stoning, sandpapering, etc., sets free a large amount of grit and dust so that the windings and leads should be protected as far as possible. A cloth head may be placed over the commutator leads and bound securely to the commutator and to the edge of the armature. A long-hair, stiff

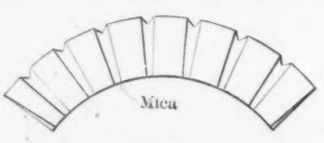


FIG. 5.—COMMUTATOR WITH GROOVED MICA.

bristle brush or duster may be used to dislodge the dust and dirt, or, better still, a bellows or a jet of compressed air.

A particularly effective way of treating flat or blackened commutators is to use an ordinary three-cornered file and file out the mica between bars until the file touches on both bars as indicated in Fig. 5. A commutator treated in this way will usually wear true and bright, and will give less trouble from short-circuiting than one in which the mica is left in the usual condition. The dust does not stay in the slot, and as the sur-

face of the mica will measure about twice as much as in the usual way, the insulation between bars is higher. An explanation of this may be that many commutators are assembled with too hard a grade of mica, and the copper wearing faster than the mica causes the surface to become uneven, hence the flashing and bucking which flatten the commutator. This method of treating commutators is especially recommended in cases where motors or generators have more than one coil per slot in the armature.

Fig. 2 shows a device for cleaning commutators. It consists of a wooden base having affixed at one end a tightening device and on the other end is a recess containing a dust box for collecting the copper dust. The grinding cloth, preferably of carborundum, rests on an elastic cushion and can be easily removed and renewed by releasing it from the tightening device. The dust box is provided with a strip of rubber which impinges on the commutator so as to rub off the dust which

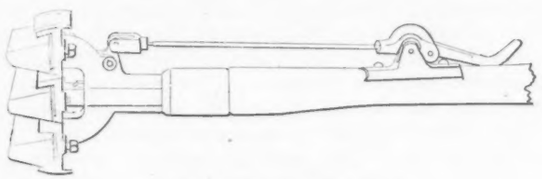


FIG. 6.—COMMUTATOR GRINDER.

clings to it, and it is further enforced by a brush placed directly in back of it. The rubber is housed in a wooden batten somewhat similar to a weather strip. A long, pivoted handle is provided so that the device may be fulcrumed at some convenient point in order to obtain sufficient pressure to bear on the commutator surface.

A commutator which has become eccentric, or has high or low bars, or in which the insulation between segments projects beyond the surface of the bars should be turned or ground down until the inequalities of the surface have been removed. This may be done by means of many special commutator tools which enable one to turn down or grind down the commutator without removing the armature from the frame. Some of the devices use files for this purpose; but the writer does not favor the use of a file except in extreme cases. Many of the grinding tools also use emery wheels, but these are open to objection because the emery is apt to injure the insulation between the segments. Carborundum is to be preferred for this purpose, as it is a non-conductor and possesses better cutting or grinding qualities than emery. The writer is not very conversant with the turning tool attachments, of which there are many, and so will confine himself to some of the grinding tools.

Fig. 6 shows one of the simplest commutator truers, which is applied by hand. The abrasive surfaces are self-adjusting to any radius, the outer blocks are fixed while the center block

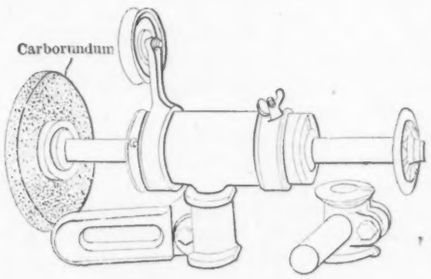


FIG. 7.—COMMUTATOR TRUING DEVICE.

is movable by the hand lever so as to adapt itself to any curve. The abrasive substance contains no emery and having three points of bearing, it necessarily cuts true. Fig. 7 shows a commutator truing machine in which the grinding wheel spindle is driven by means of a round belt passing around the commutator or shaft. The grinding wheel spindle is slotted to allow of lateral movement of the wheel across the face of the commutator. The feed is controlled by hand, the depth of cut being set by means of an eccentric gear. The grinding wheel is of carborundum, and the device is provided with suitable clamps for affixing it to the rocker journal or framework of the generator or motor. Another machine having a clamp arrange-

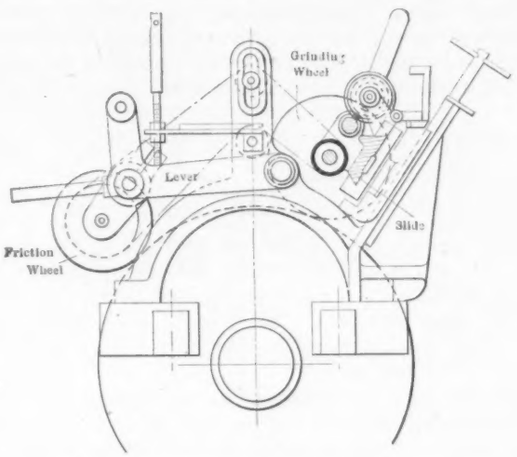


FIG. 8.—COMMUTATOR GRINDING MACHINE.

ment for attaching it to the brush-rocker journal is shown in Fig. 8. Where no rockers are used, the machine is fastened to the nose of the outer bearing. Distance rings of different sizes are used when necessary to fit various sizes of rockers. In working, the grinding spindle is driven direct by means of a specially prepared rubber friction wheel running on the commutator. The grinding wheel moves to and fro across the face of the commutator and in all except the hand-feed machines is automatically reversed at each end, being so constructed that stops can be set as in a planing machine, grinding the surface right up to the connecting wires and back to the edge. The grinder runs in a direction opposite to that of the commutator.

BROOKLYN, N. Y. C. J. THOMAS.

A NOVELTY IN ELECTROLIERS.

An interesting novelty in electric standards and fixtures is shown herewith. In the device a certain portion of the fixture moves to another position as the lamp lights, thus causing the electrolier to assume a different aspect, according to whether the lamp is lighted or extinguished.

The movement is accomplished by means of a small solenoid *A* suitably arranged, which is controlled by the lamp switch, so that the action is entirely automatic; the movable member resuming its position as soon as the lamp switch is turned to extinguish the lamp.

The artistic effects which may be obtained from this simple movement are innumerable. A button is pressed and the bronze hall figure of a sturdy yeoman swiftly, yet without vibration or shock, swings a lighted lantern high above his head, where it remains until the switch is again operated, when the extinguished lantern is returned to his side. In this case the arm is pivoted at the shoulder. A short shaft extends inwardly and is fitted with a yoke. To this is fastened the solenoid core and the counterweight. In this instance a dashpot is used to regulate the action, and in all of the various applications of the device the weight of the movable member is counteracted by weights or springs.

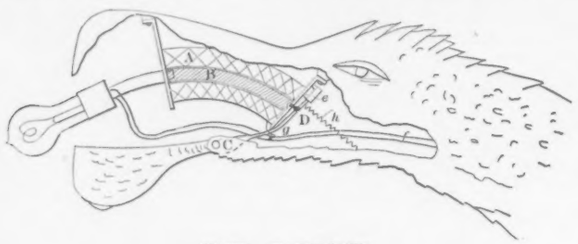
A tasteful urn or vase is fitted with lamps and the solenoid auxiliary. When a switch is turned, the upper portion of the urn rises some 3 ins., forming the shade of a very attractive electrolier. The drooping petals covering a single lamp in its socket expand as the electricity is turned on, forming an excellent shade. The mouth of a dragon or griffin opens as a switch is turned and a lamp protrudes. Similarly the doors of

a quaint English inn open when a button is pressed and a damsel appears with a cheerful light upraised.

Though its adaptation to ornamental standards and newels has thus far received most attention, the device has other advantages.

In desk fixtures or on walls where space is limited, it may be so arranged that the lamp emerges from a recess when the switch is turned and automatically recedes when turned off. A shade designed to cover the opening leaves the wall flush.

The mechanism is in all cases very simple and the additional energy required is kept at a minimum. Where solenoids of



NOVEL ELECTROLIER.

considerable size are used, these are arranged to cut off automatically when the action is complete and the core is held in place while the lamp is burning by a small retaining magnet. In the illustration the letters have the following significance: *A* is the solenoid; *B* is the core; *C* is a pivot; *D* is the connection of lower jaw to core; *E* is an iron counterweight; *F* are the wires; *G* shows the connections to the solenoids, and *N* is a spring.

Quincy, Mass. R. P. Irving.

NOVEL CONDENSING EQUIPMENT.

A very complete and somewhat unusual system is in use in this city for condensing the exhaust from the engines and for cooling the condensing water, the supply being taken from the river. There are five units in the engine room, three of 1300 horse-power and two of 2400 horse-power. Admiralty jet condensers are used in connection with the three small units and for the two large engines condensers with a capacity of 60,000 lbs. of steam per hour are installed. A third condenser of the same size is connected so that it may be used on one of the large engines or any of the small engines. Before the installation of the present system, much trouble was experienced when the river was muddy, with the sand cutting out the condensers. The new arrangement, with one large condenser constantly in reserve, will provide against any possibility of shut down from sand troubles. An intake reservoir 12 ft. wide and 24 ft. long is carried down 24 ft to bed rock and is provided with screens on the river side and on one end, through which water enters from the adjoining sand formation. A settling basin 8 ft. x 5 ft. adjoins the reservoir and is carried down to bed rock. Water that is drawn directly from the river has a chance to settle in this basin, and is then carried into the intake reservoir through a gate. A centrifugal pump with a capacity of 2500 gals. per minute pumps the sand and sediment from the basin into the river. From the reservoir the water flows naturally through a concrete conduit 6 ft. wide x 14 ft. high, resting on bed rock, to the side of the boiler room basement. From that point three 14-in. pipes carry the condensing water to the engine room, to the large condensers. The small condensers are connected separately by 10-in. pipes with a 14-ft. x 14-ft. reservoir. The discharge from these three small condensers is carried through a pipe of increasing size and empties in a 30-in. pipe that also receives the discharge from one of the large engines and the reserve condenser when it is in use. This reserve condenser is connected directly with the small condensers by means of 16-in. pipes through an 18-in. and a 20-in. header. The 30-in. pipe and a 20-in. pipe from the condenser of the other large engine empty into an open hot-water reservoir outside the building that is 8 ft. wide and 10 ft. deep. From this reservoir the hot water is raised by centrifugal pumps to the cooling tower and discharged into a 4-ft. brick conduit and cast-iron pipe, or by opening a gateway passes directly into the 4-ft. pipe. In this pipe the water flows by gravity to the river or may be diverted by a gate into a 6-in. conduit to the reservoir connecting with the small condensers and from these it runs to the intake reservoir, thus completing the circuit. By this arrangement when the river is clean and suitable for condensing purposes, the cooling tower may be cut out and the water permitted to discharge into the river. In case the sand and dirt in the river make the water unsuitable for condensing purposes the cooling tower may be brought into service and the same water circulated continuously. The cooling tower has a capacity of 15,000 gals per minute. It is 50 ft. high and has a base dimension of 20 ft. by 90 ft. Across the lower portion of the tower and staggered in position are arranged over 300 planks. These are set 6 ins. apart, with 8-in. vertical spaces. Each plank consists virtually of nine ¾-in. x 6-in. wooden strips, fastened with end and intermediate 2-in. x 4-in. cross pieces, so that five of the strips form the top of the plank and four the bottom. Two-inch pieces are provided between the strips and the top and bottom spaces are staggered. The hot water from the condensers is raised to the top of the tower and falling onto the planks, is broken into a fine spray by the time it drops from plank to plank and reaches the bottom. The water heats the air in the top portion of the tower and thus creates a natural draft upward, cool air entering at the bottom and passing up through the descending water spray. The water thus passes out at the bottom comparatively cool. The tower is built entirely of wood, except the covering for the sides, which consists of corrugated iron. The two centrifugal pumps used to force the water to the top of the tower are electrically driven.

Denver, Col. J. F. Logan.

AN INTERESTING PROBLEM.

The town of Willoughby, Ohio, will soon find itself in trouble unless it immediately proceeds to put in adequate waterworks and electric light service, both of which are at present owned by the corporation of Willoughby.

Some time since it was voted to sewer the village and an elaborate system of double sewerage is now in course of installation; a storm sewer of large pipe being run along most of the streets and a sanitary sewer being placed immediately adjacent to the storm sewer. The sanitary sewer is of smaller pipe and both sewers have a common outlet a mile or two long, at some distance below the village.

The sewer system is approaching completion, buildings are being connected, and soon the system will be ready for use, but here the first part of the problem presents itself as follows: The location of the streets of the village is such that almost every one of the sewers terminates in a dead-end of pipe, and almost every sewer-branch requires an automatic flush tank for the proper flushing or washing out of that particular sewer. The amount of water required daily by each flush-tank is comparatively small, but the entire number of flush-tanks make necessary an additional daily supply of 10,000 gals. of water for their proper operation.

The connection of the houses with the sewer system, the opening of many new bathrooms, wash basins and other water-using devices will result in the citizens of Willoughby using considerably more water. At a mass meeting of the citizens, on Nov. 2, the attorney of the village corporation told the citizens flatly that the present municipal water pumping and electric installation "would not supply enough water to extinguish a brush-heap, much less to meet the demands of a serious fire." The electric installation is operated far beyond its rating and may break down at any moment, leaving the town in darkness.

The present water supply is obtained from a river which flows through an alluvial valley lined with mostly clay and soft shale. The condition of the water during a storm must be seen to be appreciated. A gravity system is used, and the storage reservoir is supplied by a 10-in. pump, which in turn is con-

nected to an 8-in. supply pipe, both having been in service 15 years. All the pumping must be done in the day time, as at night the boilers must be used for furnishing steam for driving the electric light plant.

The electric generator is an old-timer, and has, according to the report of examining engineers, an efficiency of only 45 per cent to 48 per cent, and is overloaded all the time. In fact, it is impossible to obtain any energy for lamps for new houses or for electric signs on account of the overload already upon the generator.

In the very immediate future it will be absolutely necessary to build a new power plant which shall be able to run both the water and electric installations at the same time, though usually a night and a day turn of each in succession will suffice. A filtering plant will also be necessary. The electric plant must be large enough to handle a fast-growing business, for at this time there is not even a fan motor on the circuits.

Estimates have been made upon the cost of a combined pumping and electric plant, and the figures, including the filter plant, are $27,000, but the citizens are horror-stricken at the idea of spending so much money. Some of the people want to patch up the plant for $9,000 or $10,000 to do the necessary work, and others talk of selling the outfit to the Cleveland, Painesville & Eastern Railway, an electric transportation line which passes through the city of Willoughby; the water and electricity to be furnished by that company.

There is a field for a large plant in place of the one described, and some enterprising electric man may do good business by getting next to the city officials and devising some means of installing the needed machinery for a price within the reach of the citizens. It may be added, to illustrate the loose methods now in use, that the city lamps, a number of arcs, and 25 to 35 incandescents, are lighted with never a cent's worth of credit from the city, but their cost is charged to expense of maintaining the plant.

In addition, there is a lack of proper management all along the line. The lamps and circuits are in the tender care of the police force, the chief of the fire department—a business man, by the way, and a very good man, though he is no mechanic, has chief care of the pumping and electric plant. At present there is no engineer or mechanical man upon the board of public works, and it is not to be wondered at that the plants in question are in the condition described above. Some electric light man might succeed in obtaining the plant upon a franchise of several years' duration. Action of some sort must be taken at once, for the time is ripe and the necessity for more water and electricity will be a vital one before another year has gone.

WILLOUGHBY, OHIO. JAMES F. HOBART.

OPEN AIR SECTIONALIZING SWITCH.

An open air high-tension switch which is primarily a line-sectionalizing switch and is not intended to take the place of oil switches in power houses or sub-stations has been in operation at the Roanoke sub-station of the Fort Wayne & Wabash Valley Traction Company. This was designed, I believe, by Mr. M. J. Kehoe, the company's engineer, and serves to sectionalize the lines in the event of trouble. The switch has the advantage over the usual forms of high-tension switches in that the insulation of the line is maintained. The wires are, in fact, carried through it and the terminals are supported on standard line insulators. The high-tension wires of one side of the line are lead over top cross-arms and down to three fixed brass bell-mouths supported on line insulators. The wires of the other side of the line terminate in three brass rods, mounted on insulators, which are themselves carried on a wood frame. This frame is supported on four long arms pointed at their ends so that the frame may be thrown backward or forward. When thrown forward the terminals of the brass rods enter the fixed bell mouths and the circuit is closed. Throwing the frame to the rear causes the rods to recede a foot or more from the bell mouth, and the circuit is opened. The switch is especially useful at junctions where two or more high-tension lines diverge after having been carried on one pole line for several miles. When trouble occurs on one of the lines beyond the junction, it is frequently necessary to shut off the circuit at the station from all paralleiing lines before repairs can be made. With the switch described a lineman finding trouble on the line can break the circuit at the nearest switch and make repairs without delay. The danger of misunderstanding whether or not the switches are thrown off in the station is avoided, as the man making the repairs can see for himself that the switch is open. Although used on a railway line, the device is of service to electric light men, since it is applicable to high-tension lines feeding lighting systems, and for that reason your readers might be interested in it.

COLUMBUS, OHIO. R. C. GORDON.

SWITCHBOARD INSTRUMENTS.

Too much cannot be written about the care and accuracy of central-station switchboard instruments. It is taken for granted, too often, that the meters are correct when a little testing might reveal the opposite to be the case. Usually instruments of such capacity are installed, that, under normal working conditions, the needle of an indicating instrument will hover about the middle of the scale. By this means overloads are provided for and the meters are sufficiently accurate for light loads. The watt-hour meters, however, should be of such size that under normal conditions they will be fully loaded and one with a rapidly moving train is preferable to one with a slowly moving train. The chief causes of inaccuracy in meters are stray fields and blunted jewels. There are many switchboards where to the writer's knowledge the effect of stray fields renders the meters very inaccurate and this is more apt to affect alternating-current instruments than direct-current instruments. The stray fields are in almost all cases due to faulty switchboard design and to careless connection of feeders, especially where these are brought to the board from above. Blunted jewels are in most cases due to careless handling of the instruments and a lack of appreciation of the delicacy of parts of the mechanism. It is not uncommon to see instruments dropped on a table or placed on the board while hammering is going on in the immediate vicinity sufficient to jar the instrument and damage the jewels. Now no one expects that the same care will be taken of switchboard instruments that is taken of laboratory instruments or that their accuracy would be as great, because conditions do not permit it; but if a correct impression is to be obtained of the operating efficiency of the station, the instruments should be calibrated about every other month, and suitable arangements should be made for conveniently doing the work. In some cases the switchboard builders, if requested to do so, will provide testing plugs on the panels both for the current coils and for the potential coils of the instruments so that it is a comparatively easy matter to connect a portable testing meter in order to calibrate the instruments. On polyphase circuits two independent wattmeters are easier to calibrate than a polyphase meter. The instruments should be properly installed and for this purpose it would be best to follow the manufacturer's instructions and diagrams. On alternating-current switchboards there are, of course, many instruments which might tend to confuse the attendant. Some of these might be omitted in some installations, as, for instance, on a three-phase circuit feeding synchronous machinery, two wattmeters could be replaced by a power-factor indicator. With the increasing use of transformers for switchboard instruments, checking of instruments is not so difficult and inconvenient as heretofore. The potential transformers are quite reliable and in fact more accurate than is ordinarily supposed. Any errors of the series transformer may be compensated for by adjusting the meter and the added convenience of these more than compensate for any slight errors which they might introduce. The chief point is to have the switchboard instruments reasonably correct and to keep them so.

NEW YORK. FREDERIC LANGE.

QUESTIONS AND ANSWERS.

Does oil affect the insulating properties of mica appreciably? A. S. W.

Yes. This is one of the chief causes of commutator troubles. A sheet of mica that would resist an e. m. f. of 10,000 volts for an unlimited time in air has been known to break down instantly under oil at an e. m. f. of 5000 volts.

Would it be profitable to install mechanical stokers in a station having a rated output of 1500 kilowatts? D. J. B.

It depends on the fuel used, character of the load and other items too numerous to mention, whether or not mechanical stokers would be profitable in a station having such an output.

Can a rotary converter be run inverted; that is, can it be made to give alternating current at one time and direct current at another? S. E. F.

Rotary converters are run inverted in a number of stations which supply both alternating current and direct current apparatus. Motor-generators are, however, used more often for this purpose.

How may carbon brushes be tested? We have recently had a number of commutator troubles which we believe are due to the brushes. J. B. C.

To determine whether the brush is homogenous and free from laminations and hard specks which scratch the commutator, break the brush and the fracture will usually show the grain and any imperfections in homogeneity.

Can boilers using buckwheat coal for fuel be as easily forced as others burning a better grade of fuel? B. Q.

Boilers using the low grade anthracites can be more easily forced than those using the better grades of fuel, as it is always possible to enrich the fuel by mixing with it bituminous coal. In fact this is the usual way of taking care of the peak load in a great many stations using buckwheat coal.

Should watt-hour meters be placed on the front of the switchboard or behind it? I find that there seems to be no standard rule since both front and back mountings are used indiscriminately. D. P.

The switchboard attendant should have before him only such instruments and such apparatus as he must necessarily use, and although it is quite common to see watt-hour meters mounted on the face of the board, this practice is waning. There may be good reasons for placing watt-hour meters on the front of the board other than for show; but ordinarily there are not.

Will a single-phase watt-hour meter record the energy consumed by a two-phase motor, if a constant of 2 be used? W. C. D.

If the phases are perfectly balanced, a single-phase watt-hour meter connected in one phase will record one-half of the energy consumed by the motor. Such a condition, however, is not usual and it would be preferable to install a polyphase watt-hour meter or a single-phase meter in each phase. In the latter case the sum of the watt-hour meter readings gives the total energy consumed.

How is ozone produced electrically? R. B. B.

There are many forms of apparatus devised for the electrolytic production of ozone. The general principle underlying the construction of all of them is to pass a stream of dry air between two conducting surfaces which are close to each other. The conductors are subjected to differences of potential which are rapidly varied in amount over wide limits. The high tension of electrostatic machines, induction coils, or transformers are used. Disruptive discharges may be employed for producing the rapid change of potential difference.

When installing a two-phase motor, is it better to supply it with energy from two single-phase transformers or from a polyphase transformer? T. O. M.

While the polyphase transformer is more compact and cheaper, the general practice is to install two single-phase transformers because of the advantages of simplification of the system, applicability of the single-phase transformer to either lighting or motor loads, and the convenience with which repairs can be made in case one transformer has been destroyed; since it is usually possible to find another single-phase transformer. In ordinary central-station work, polyphase transformers could not to be so easily replaced, as they are not usually carried in stock.

A number of our commutators are troubled with loose leads due to the solder coming out, and although the leads have been resoldered a number of times, the trouble does not seem to lessen. How can this be remedied? F. G.

The probabilities are that the commutator becomes quite hot in operation and that the solder used in fastening the leads is not suitable for the work because of its low fusing point. It is important where motors are operated under load and heat up considerably that some account be taken of this condition. This is very often overlooked, and where the temperature during operation becomes quite high, only commercially pure tin solder should be used. This has a high fusing point, and in connection with it, it might be well to use an alcoholic solution of resin as a flux rather than a flux containing acid.

How may iron be preserved from rust? J. K.

Melt a lump of camphor in some lard, using a pound of the latter to an ounce of the former, and color the mixture with black lead till it resembles the color of iron. Clean away all rust that is causing difficulty or clean up the iron parts that it is desired to treat, and then rub on this mixture. After it has remained for a day, the parts should be cleaned up again with a cloth. A mixture of common rosin with pure olive oil and spirits of turpentine forms another material which will act very well towards preserving iron from oxidizing. It is always better and easier to keep the iron parts clean and clear from rust formation than it is to remove the rust once it has gotten a start.

A 3-hp compound-wound motor in starting blew a 35-ampere fuse with the handle of the starting box on the second notch and when under only a light load. The fuse was replaced by another, and the motor started without load, when it ran all right until a normal load was put on it. It then speeded up to over normal speed and the fuse blew. Kindly let me know the cause of this. W. H.

From the information supplied we are led to believe that the terminals for the series field winding are reversed from the proper position. That is to say, it is probable that the machine is connected in circuit in such a way that the series field coil opposes the shunt field coil in its magnetizing action. It would be well to reverse the connections to the series field coil, leaving all other connections as they are. If this change does not overcome the difficulties, it is probable that the starting rheostat is improperly connected in the circuit. However, we are unable to determine all the possible inaccuracies from the limited information supplied.

Why is it that in railway switchboard practice the equalizer is connected on the negative side, while in lighting switchboard practice the equalizer is invariably connected on the positive side? B. T. F.

Not all railways connect the equalizer to the negative side of the system; but there are good reasons for so doing. With the equalizer connected to the negative side, the possibilities of short circuits between the equalizer and ground are reduced, as there is a very small difference of potential between them. Complication on the board is also reduced as one switch only is required instead of two or three which are needed when the equalizer is on the positive side. The instruments can also be connected more directly and the arrangement of lightning arresters is also much simplified. It is, of course, understood that in railway practice, the negative is grounded and the equalizer is not placed on the switchboard, but under the floor, and the equalizer switch is mounted on a panel in front of the generators. With rotary converters, equalizing on the negative side simplifies the switchboard wiring and this is usually done except where the rotary is called upon to work in parallel with direct-current generators in the same sub-station.

CENTRAL STATION SALE OF CURRENT.

How to Make Newspaper Advertising Pay Central Stations.

BY WILLIAM D. MCJUNKIN.

It is only during the last few years that central-station managers have been dealing seriously with the problem of selling energy. Production has monopolized their attention. And during these few years a wonderful impulse has been given to newspaper publicity as a means of getting new business. Whatever may be said theoretically about the relative merits of sending out advertising material by mail, the overwhelming verdict of central stations from actual practice has been in favor of newspapers.

In a long advertising experience I have become more and more convinced of the relative inefficiency of mail matter in getting results, unless newspapers are used in conjunction. The mail is overcrowded with circulars. People get so many stereotyped appeals of this sort that they become indifferent to them, if they open them at all. The busy man has little time for third-class mail.

Newspaper advertising has a number of distinctive advantages. It is inevitably read. It makes a persistent appeal. No man is too busy to read his newspaper. No up-to-date woman neglects the advertising pages. Whatever may be imagined to the contrary, there is a deep-seated confidence in the press on the part of most people. They believe its announcements more readily than a printed circular mailed by the advertiser himself.

Another point of advantage not always realized by the public service corporation is the incipient good will engendered by systematic advertising in the press. People like to follow an interesting campaign. They are favorably influenced by it. Housewives look for the announcements for the information afforded. Everybody enjoys good pictures and clever type arrangements.

This makes it all the more incumbent upon central-station advertisers to print only the best. Newspapers afford wide and persistent publicity. Your message is in the limelight. A poor impression goes broadcast and does harm. Inferiority is as fatal as the slovenly appearance of a salesman in selling his goods.

In looking over central-station advertising in the daily press coming to my office from all parts of the country I have been struck by the crudeness of so much of it, often inferior to the local department store announcements appearing alongside. Stiff, makeshift designs offer an impassable barrier to the reader's attention. Jumbled type bodies distract it. And the copy is often limp and confused. The impression is weak. The space wasted.

A number of the larger companies even advertise spasmodically, taking a half-page or full-page now and then, with worst possible effect. It is seldom possible to fill a half-page with live, interesting matter. The space must inevitably be wasted or stuffed with unwieldy looking type. There is no value in such an appeal. It looks like blackmail to intelligent readers, as if the newspaper were being bribed. Without a systematic schedule of insertions, no effective interest can be aroused. People forget an isolated advertisement. They are not in any

Why Use Oil Lamps
when electricity is so much cleaner and more convenient? There is no soot or odor and no need of matches. For decorative effects in the home electric light surpasses any other form of illumination. It is the most desirable light — from every point of view.
Electrical Table and Stand Lamps
burn long hours daily, and under our system of charge earn a low rate, thus materially helping to reduce the average rate for your total lighting in the house. The new scale of reduced rates renders all forms of electric lighting economical.
At a Merely Nominal Expense
Chicago Edison Company
Commonwealth Electric Company
139 Adams Street
NO ARCHITECT would think of designing a modern house without electric light. Do you have it in your home? Call Main 1280 about the reduced rates.
Chicago Edison Co.
Commonwealth Electric Co.
139 Adams Street
Electric Signs Free
Chicago Edison Company
Commonwealth Electric Company
"Steam is Out of the Question for Power in Our Plant"
"We have used electric motors for so many years to advantage that we could not consider any other form of power."
"In a book bindery like this, electric power is by much the most efficient. Rarely—if ever—breaks down."
"The motors need practically no repairs. Once in a while a fuse may burn out, if overloaded. We have a motor in this shop which has run continuously for nine years without a hitch or penny of expense."
Extracts from interview with Brock and Rankin, operating a large plant with electric power from central station. Further details furnished on application. Our engineer will gladly make a free test of your plant. Call Main 1280.
Commonwealth Edison Co.
139 Adams Street

FIGS. 1, 2 AND 3.—NEWSPAPER ADVERTISEMENTS OF THE CHICAGO EDISON AND COMMONWEALTH ELECTRIC COMPANIES.

receptive frame of mind for the next one or the next solicitor who happens along. The shot has been wasted.

This backward condition of electric light advertising is, of course, due to inexperience in the field and the employment of inferior syndicate services because they are cheap. Such false economy is being rapidly realized by a number of the larger and more progressive central stations, who to-day are spending liberally for profitable advertising.

What is good advertising and what should it aim to accomplish? This is, perhaps, too broad a question for one man to answer dogmatically, and I shall confine suggestions to my own experience in central station publicity.

The difficulty in getting results out of a protracted newspaper campaign for any public service corporation is in maintaining

a live interest. Dignity can not be sacrificed. There is no room for sensationalism or levity. A straightforward business tone must be maintained, and still an interesting story must be told. To overcome this dilemma unfailing ingenuity must be exercised in introducing variety in set-ups and designs, as far as appearance goes, and in affording valuable information, as far as copy is concerned. The merely fanciful will not do. The humorous still less. People are serious when they do business. They do not care to be entertained.

To scrimp on outlays for art work is mighty poor economy. This is a very common mistake among the inexperienced. The cost of space is a big item, after all, and should be made to pay for itself handsomely with handsome material. Cheap drawings are useless, and cheap cuts will spoil the cleverest idea. For house lighting a decorative artist can with profit be employed to draw exquisite interiors—bedrooms, living rooms, bath rooms, etc., illustrating most daintily the artistic and hygienic possibilities of electricity in the home. For cooking and heating advertisements the use of models is desirable, dramatically photographed in the very act of handling the various apparatus. The lifelike reproduction of a womanly personality in such announcements has much to do with winning feminine favor for electric cooking. With the electric devices thus vividly represented in the hands of a pleasing demonstrator, the total impression made by the design is inviting and homelike.

In advertising electricity to manufacturers a very different course is called for. The illustrations of machinery and power plants should be made with mechanical nicety and truth, and where vigorous pictures are needed, the bold impressionistic work of a sketch artist will make the argument emphatic. Simple type advertisements are effective for power advertising. Heavy, clean cut headlines arouse interest and lead directly into terse argument. Business men have no time for frills. They must be caught on the wing by type bodies set up in strong, clear contrast, throwing the salient points of a convincing argument into relief.

The skilful massing of type effects is an art few advertisers understand and makes a vast difference in the impression produced. The human mind is normally lazy and does not readily attack involved composition. You must catch the eye with beauty and boldness both in the headlines and type bodies, and then the full force of your argument is free from obstruction. Shots from a sighted gun are far more effective than a whole broadside at random.

The "interview" form of copy has been tried very successfully. Verbatim statements of motor users, regarding effectiveness, cost, increased output, cleanliness, etc., have been massed into short paragraphs and printed with quotations, the material being obtained at first hand from engineers and proprietors in the plant. Sometimes names may be given identifying the plant, care being always taken to preserve as much as possible the vivid expressiveness of the talkers in their statements.

On the higher plane of professional work newspaper advertising becomes the most potent means central stations can employ for getting new business. It is especially valuable in promoting anything as new as electricity in the household. People are strangely ignorant of the real advantages of electric light over any other form of illumination. They know practically nothing of electric devices for cooking and heating. Electric flat irons, curling irons, coffee percolators, toasters, ovens, vibrators, fans, dim-a-lites, hylos, heating pans, etc., conveniences without limit, are eagerly wanted by a prosperous community when rightly understood. Walking into the office of a large metropolitan daily a few months ago I was surprised to learn from the advertising manager that he did not know exactly how an electric flat iron looked—how heavy it was—whether it cost $2 or $10—whether it was practical or not—or any of its advantages. If keen-witted business men are thus unaware of the commonest of electric devices for the home, where would the great army of housewives come in—the people who need an electric flat iron?

Electric Light in New England.

By William H. Stuart.

In the smaller cities throughout New England electric lighting takes the smaller portion of the central station load, motor business taking the greater share. The number of gas consumers is overwhelmingly greater than the users of the electricity. This state of affairs can be accounted for by the fact that the cities and towns of New England are manufacturing centers, having about three-quarters of their population employed in the factories and mills with an income capable of allowing only oil or gas to be used as an illuminant. Then, again, the stores are open only one or two evenings each week.

The central station managers have found that the lighting business, if any was to be obtained, is commercial lighting, and in the majority of the cities low and attractive rates are offered for this class of business. Sign and outdoor lighting especially have been favored with exceptionally advantageous offers. For instance, in the city of Danbury the sign rate is 5 cents per kw-hour, the regular lighting rate being 12 cents per kw-hour, and the same can be said of Derby, where the sign rate is very low, the regular lighting rate being 12 cents.

In one of the cities a proposition was made to a storekeeper doing a moderate amount of business to install a number of incandescent lamps in his windows and keep them burning on the evenings he was closed until 11 or 12 o'clock. After some hesitation, he finally agreed to go ahead in the matter and await results. The show windows were attractively dressed, and when lighted at night stood out prominently along the thoroughfare, a bright spot in the dark. The storekeeper watched the number of people who stopped and looked at the windows, and found that it was good advertising. The neighboring storekeepers were all approached and the proposition laid before them; they were skeptical, and while some of them were induced to install signs, these were only burned on the nights the stores were open. This company then let the matter drop for some time. A little later a large company operating stores throughout the country opened a store in this city. They, as was their custom, wired the store so that the windows could be used for night display. They not only kept the windows lighted, but maintained a display as attractive as it was possible, changing it every week. In a short time some of the other stores ventured on lighting their premises during the night.

In another city the electric light company thought by doing the wiring at cost and allowing the consumer to pay for it as he chose, it would be an inducement; after a year's trial it found that this was not entirely satisfactory in that it attracted a class of consumers who were most likely to allow their bills to run too long or never pay them. A new scheme was then tried, that of giving heating and cooking appliances to small residential consumers, and signs to the commercial consumers. The company also did additional wiring free for all commercial consumers, providing the additional equipment was not too large and was likely to bring some return on the investment. This, after a trial, showed good results, but after the company gets a good foothold it will drop this plan and hopes to gain the rest of the possible lighting by straight soliciting methods.

This same company started at one time a thorough canvass of its territory. It sent solicitors to every house and building in the city, obtaining information concerning each call, which was reported on a card and turned into the office each night. The data the card called for were the address, the name, business and nature of premises, owner, owner's address, light used inside, light used in windows, sign used, if any, kind of power used, whether premises are wired, date and name of solicitor. On the reverse side of this card a space was ruled off, asking for a report in detail with reason for not wanting, also a space for wants. When a complete canvass was made the cards were sorted according to streets and street number and filed away. All cards that showed a report which would give a chance for a return call from the solicitor were noted and the solicitor paid another visitor. A great many of the cards bore requests for

estimates. This request was attended to with caution in this way: It was found that a prospective consumer generally wanted to know what it was going to cost him to wire the premises, and if good judgment was not used it was found that the price would amount to too much. Once having him satisfied on the wiring cost it was comparatively easy for the company to have him sign. The cards were all kept in order and a year later were all gone over again, and the additional information and data obtained were added. A different solicitor was used in each district on the second call. The company found in this second canvass considerable changes and also quite a number of new buildings and enterprises. This card is used quite often for reference, and is now kept up to date.

In New Bedford a good opportunity was presented to get unusual public attention focused upon electric lighting. During September a one-week carnival was given by the citizens during "Old Home Week." This was advertised around extensively for some time beforehand, and various committees were formed to carry out the different details. Among the most important was that of the electric lighting of the streets, public buildings and landmarks. The New Bedford company went into the matter whole-hearted. They agreed to furnish free of charge all the electric energy during "Old Home Week" to anybody who would furnish a special electric equipment for the occasion. This generous offer was readily accepted by the citizens, and the newspapers were filled with comments upon the public spirit of the electric light company. The route of the carnival procession and the abutting buildings were bathed in a flood of electric light each night, and everybody was loud in his praise of the electrical demonstration. Upon the roof of the City Hall was outlined with colored electric lamps of 16 candle-power a large spouting whale, emblematic of the principal industry of early New Bedford. This display created a great deal of discussion, which is still continued, especially concerning the way in which the whale spouted. The whale was constructed so that a double row of green colored lamps represented the whale spouting in a direction away from his head. Immediately the next morning an old whaling master called at the office of the electric company and stated that a whale spouted over his head in the opposite direction from the one on the City Hall. The company applied for information on the subject to the newspapers, which, after looking the matter up, had a free-for-all discussion in their columns as to the direction the spout of the whale should have taken. Six old whalers were found to agree on one way and another six were as determined that it should have been the opposite way. Owing to this discussion, everybody came to see and discuss the electric whale.

The New Bedford company states that it has obtained a considerable amount of lighting business as a result of "Old Home Week." A great many of the special equipments have remained permanent and the storekeepers have found that there is a benefit from night illumination. The New Bedford stores keep open only two nights a week.

Many New England companies depend upon flatirons and some other of the heating appliances to introduce electric energy in a house. One manager stated that as the direct result of the operation of a heating pad in a serious case of illness, he had secured six new consumers without any canvassing. The New London Gas & Electric Company has made a specialty of flatirons. A large sign over its handsome office reads, "Electric Irons." The company employed a lady, who went from house to house making a thorough canvass, and as she was very well known, she gained a ready entrance. A brief talk upon the advantages of the iron and an invitation to the office with several friends, where it could be easily demonstrated, was extended. Irons have been placed in a great many houses of the old consumers and have also proved an entering wedge where electricity has never been installed. At the office no trouble has ever been spared to demonstrate the various uses to which electric energy can be put. If a person after having read of some new labor-saving device made inquiry and the company did not have the article, it immediately looked it up, and if it could possibly be brought to the city for a demonstration it was done and at no cost to the person interested. Everything electrically, old or new, is kept on hand in a very neat and attractive showroom, where, from time to time, public demonstrations are given of some one thing. This helping-hand policy has gradually become well known throughout the city and has placed the company on a good basis in the public opinion.

Central-Station Commercial Development at Detroit.

About three years ago the Detroit Edison Company began the operation of a new power plant located at Delray, on the outskirts of the city. The commercial expansion of the company had previous to that time been somewhat hampered by lack of adequate generating plants for economically taking care of the large motor load. The completion of the Delray plant was the beginning of a new era in the company's development. With it in operation, plans were immediately laid and carried out to increase the company's motor load so as to supply at very low rates the numerous large and small factories of the city. Detroit is an important manufacturing center. The distributing system and power plant of the Detroit companies was described in the ELECTRICAL WORLD AND ENGINEER for Feb. 4 and Feb. 11, 1905.

It is the purpose of the present article not to take up the enlargements and changes in this distributing and generating

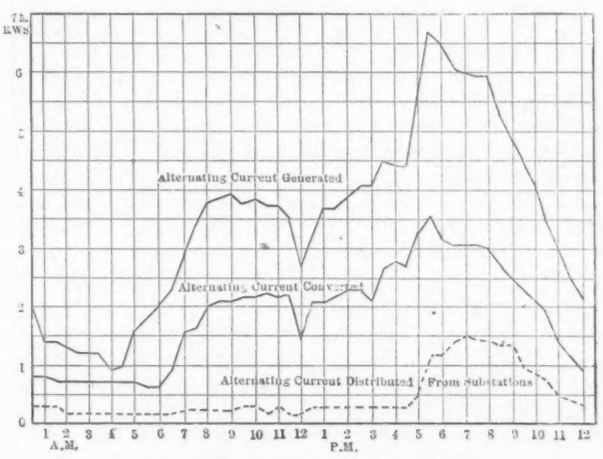


FIG. I.—LOAD CURVE, OCT. 13, 1905.

system so much as to review the commercial development and commercial methods which have made this increase in equipment necessary. It may be incidentally mentioned, however, that the load connected to the Delray power plant which was started about three years ago now requires the combined output of five 3000-kw turbo-generators; and a second power plant close to the first is now under way in which 8000-kw turbo-generator units will be installed. This growth has been due partly, of course, to the natural development of the city during prosperous times. It is not by any means entirely due to this, however. A correct commercial policy toward motor users has brought about some of the most valuable increases. Figs. 1, 2 and 3 show typical load curves for corresponding days in October, 1905, 1906 and 1907. In 1905 an important growth along the lines indicated had already been started, the Delray plant having been in operation about a year. The peak load on Oct. 13, 1905, was 6700 kilowatts, while that for Oct. 14, 1907, was 15,600 kilowatts. In these load curves the uppermost curve represents the total power generated by the 4600-volt, three-phase, turbine units. The curve marked "alternating current converted" represents the amount of power converted from alternating to direct by motor-generator sets for use in the direct-current distributing district. The curve marked "alternating current distributed from sub-stations" is self-

explanatory. The sum of the two lower curves is not equal to the total load curve of the station for three reasons: First, the line losses between generating station and sub-stations are not accounted for; second, some power used at 600 volts in railway service is not included; third, some large motors are connected to trunk and tie lines between the generating station and sub-

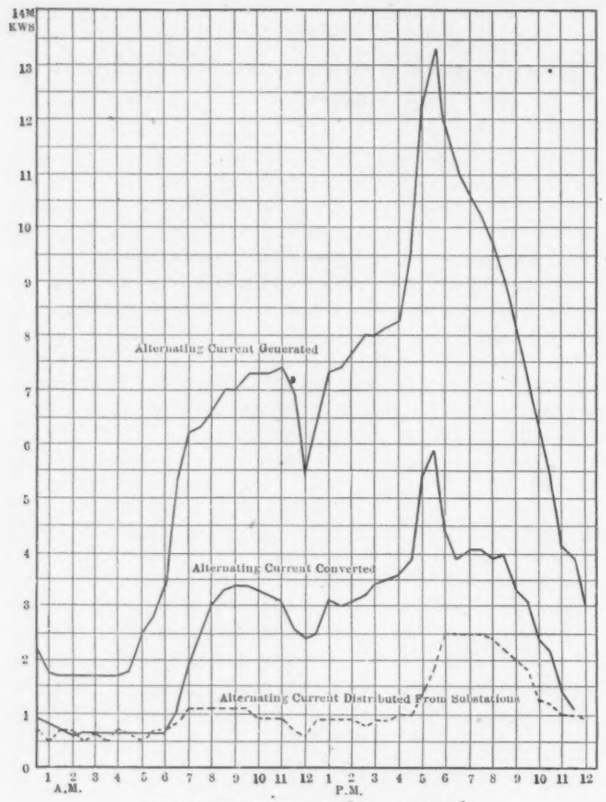


FIG. 2.—LOAD CURVE, OCT. 15, 1906.

stations, so that there is no record of their consumption. In the total generated load curve for Oct. 14, 1907, the average load was 8150 kilowatts and the load factor for the day 52.5 per cent. It must be considered in connection with the questions of peak and load factor, however, that there are a few steam stations which carry a small amount of load during the peak and have a steam heating load during the winter season.

RATES.

As the policy of a company as to rates has a vital bearing on its development in a commercial way, the very logical system of rates which has been adopted at Detroit will be of interest. All rates are published, and the system of rates is comprehensive enough to take care of practically all conditions.

Taking up first the forms of contracts there is one termed the "Electric Energy Contract" which recites that the company undertakes to reserve for the use of the customer its machinery, apparatus and lines to an extent sufficient to deliver to him at his premises electric energy at the rate of a given number of kilowatts continuously night and day, Sundays and legal holidays excepted. The customer agrees that he will not at any time take energy from the lines of the company at a rate greater than the specified number of kilowatts without notice given to the company, and that he will report to the company from time to time or will allow the company as its option to determine by measurement his actual maximum demand or rate of using electric energy. For the reservation of equipment provided for in the foregoing, the customer agrees to pay the company $4.50 per rated kilowatt of equipment contracted for per month. In addition to such payment for reservation the consumer agrees to pay 1 cent per kw-hour for energy used. Discounts, for payment within 10 days, are 5 per cent on bills up to $100 and 10 per cent for excess over $100. In case of the failure of the company to maintain its supply as before provided, the customer shall notify the company by telephone and by writing of the duration of such interruption and claim rebates at the rate of 10 cents per kilowatt of equipment per hour of such delay, this to be deducted from the gross amount of the next monthly bill before deducting the discount; but the customer cannot claim more than $4.50 rebate per kilowatt. As the hourly rebate provided is greater than a pro rata rebate would be, the company retains the privilege upon notice given the preceding day, of interrupting the supply at night or on Sundays or holidays or at such other times as will not interfere with the regular conduct of the customer's business, for short periods for the purpose of making repairs or changes of its lines or apparatus. Under this contract, the customer is not permitted to sell energy to a second party without the written consent of the company, nor does the company furnish or maintain any apparatus beyond the point of entrance of the lines to the customer's premises, nor are any lamps, lamp renewals, fuses or the service of repair men or inspectors furnished free. This contract is, of course, intended for the largest wholesale customers, and is made for three years.

Customers not wishing such a contract may obtain energy on an open order, which may be cancelled at any time. On an open order contract, the customer simply pays 4 cents per kw-hour, with discounts for prompt payment, as in the case of the three-year energy contract.

The company also has a special non-peak form of contract which is similar to the energy contract described, except that the customer pays only $3 instead of $4.50 per month per kilowatt of maximum demand or kilowatt capacity "reserved"

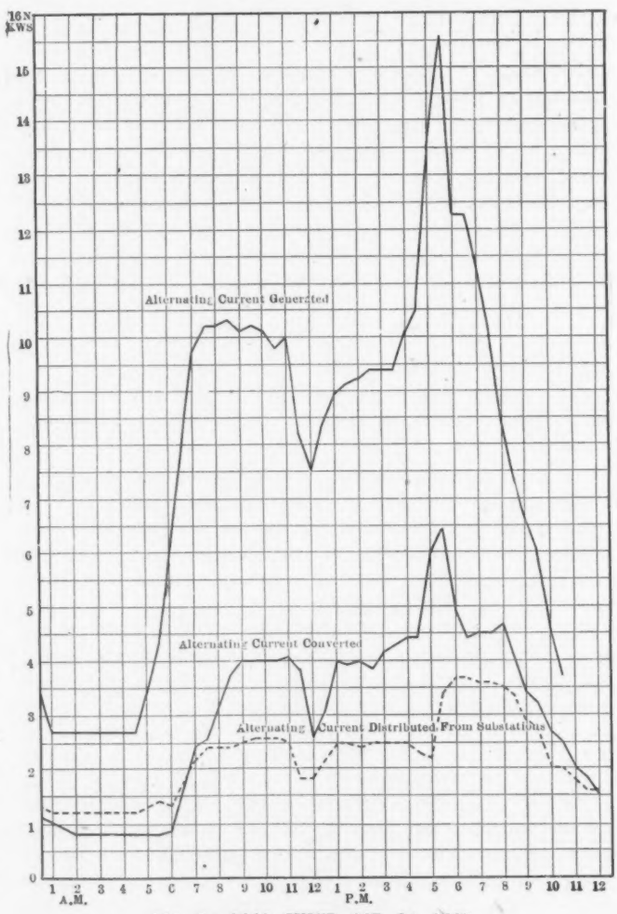


FIG. 3.—LOAD CURVE, OCT. 14, 1907.

as the Detroit contracts are worded. Not many customers have been taken on non-peak contracts as yet, and the making of such contracts has not been pushed to any extent, but the company's condition just now is such as to make it advisable to push the non-peak contract, the load being nearly up to the station's maximum output.

Residence lighting is taken on an open order contract which can be discontinued at any time, or on a one year contract. Under the open order contract the customer pays 16 cents per kw-hour up to the point where the energy consumed is equivalent to 60 hours' use per month of what the company reckons his maximum demand. For all energy over that he pays 4 cents per kw-hour. The minimum bill under an open order contract is 50 cents per month. The discount for prompt payment is 10 per cent.

The company's method of estimating the maximum demand in a residence is to count all the rooms of the house except kitchen, laundry, store-rooms and three bedrooms. Multiplying this number by 2 kw-hours gives the amount which is charged for at the high rate.

Commercial lighting is taken under a one year contract with a maximum-demand meter, unless the maximum demand is the same as the connected load; in which case no demand meter is necessary. Under this contract the customer pays 16 cents per kw-hour for the equivalent of 30 hours' use of the maximum demand and 4 cents for all above that, with a 10 per cent discount for prompt payment on bills of less than $50, 15 per cent on bills of $50 to $100, and 20 per cent on bills of $100 or more. Such an agreement is not written for a monthly bill less than $2.40. Free lamp renewals and free trimming and repair of arc lamps are included and original installations of lamps, both incandescent and arc. If the customer consumes less energy than would be equivalent to 30 hours' use of the maximum demand, he pays for the full 30 hours' use at 16 cents, as a readiness-to-serve charge.

The company furnishes free incandescent lamp renewals. It also furnishes and maintains 3-glower Nernst lamps, of which there are about 2000 in use. The maintenance cost on these lamps is about ½ cent per kw-hour. Free renewals are furnished on all larger sizes of Gem lamps, the customer purchasing the reflectors.

No flat-rate service sign contracts are made, but the company furnishes free renewals for 2-cp sign lamps, and this seems to have been a great stimulus to the sign business in Detroit, judging from the appearance of the down-town streets at night. Aside from furnishing these free renewals of 2-cp lamps, the company has made no effort to get sign business. This speaks well for the efficiency of the 2-cp sign lamp as a business getter. It allows customers with small signs to make a much better showing than they could if 4-cp lamps were the only ones supplied.

The contract department is in charge of Miss Sarah M. Sheridan. Ten solicitors are employed outside of the office, of whom four are on motor work. Besides these, there is one general motor-contract engineer who handles the most difficult engineering problems coming up in connection with the contract department. The six lighting solicitors divide the city by districts and also solicit for any small motor users of 10 horse-power or less. The solicitors for motor load are assigned cases largely according to their previous experience. These solicitors are gradually becoming specialists in handling various classes of customers. One of the lighting men devotes his time mainly to isolated plants. Fifteen isolated plants were closed down in 1907 and 12 in each of the two preceding years. About six isolated plants take summer service from the company and operate during the winter.

An interesting development in connection with isolated plants is what is called a throw-over service. Two meters are placed on the central-station service wires to the isolated plant. One of these meters is thrown on by a Hartford time switch between 1:30 to 6:30 p. m. At 6:30 the time switch throws the circuit to the other meter, where it remains until 1:30 p. m. the following day, and so on. All energy consumed between 1:30 and 6:30 p. m. is paid for at 16 cents per kw-hour; energy consumed at other times is charged for at the rate of 4 cents per kw-hour. The time switch is wound once a week. There are 55 such connections in the city. The minimum bill for this throw-over service is $1 per rated kilowatt of equipment per month up to $25. This is only in the direct-current districts where no special transformer capacity is required, and up to transformer rating in the alternating-current district.

There are over 3000 electric flatirons in use. Between 200 and 300 a month are sold from the company's display room during the summer and about 100 in winter. There are also about 250 electrically operated washing machines connected. The one used most is the "1900 Washer." From the display room the company sells nothing but heating appliances and sewing-machine motors. The sales from this room altogether amount to $600 per month. Electric irons are sold at $3.50 each and sewing-machine motors at $15.

The total connected load on Sept. 30 amounted to the equivalent of 741,849 50-watt lamps and the motor load alone equalled 252,075 lamps.

The Detroit Edison Company and the various companies through which the energy it generates is distributed are under the management of Mr. Alex Dow, vice-president and general manager.

Luminous Arc Service in Cleveland.

The Cleveland, Ohio, Electric Illuminating Company has recently started a luminous arc lamp service which, being one of the first of its kind in the country, is of considerable interest to central-station companies. The company contracts to supply energy for outdoor luminous arc lamps at the rate of $6.25 per lamp per month, and agrees to operate these lamps from dusk to 11 p. m. daily. Lamps are furnished by the company. A Hartford time switch wound once a week, also furnished by the company, turns on each pair of lamps at dusk and turns it off at 11 p. m. For the trimming and maintenance of these lamps the customer must, at the same time that he contracts with the company, enter into a contract with the Flaming Arc Maintenance Company to trim and maintain the lamp and time switch for $2.75 per month. The total cost to the customer is therefore $9 per lamp per month. The Flaming Arc Maintenance Company is practically a Cleveland maintenance branch of the Excello Arc Lamp Company. The trimmer for the Flaming Arc Maintenance Company reports to the head trimmer of the Cleveland Electric Illuminating Company, but is employed by the maintenance company and devotes his time to flaming arc lamp maintenance. All troubles on luminous arc lamps are reported direct to the luminous arc trimmer. The rate obtained by the illuminating company is about equal to the regular meter rate. Luminous arc lamps for outdoor advertising purposes are, therefore, coming into use rapidly in Cleveland. Their principal application is for lighting store fronts—a field hitherto extensively occupied by gas arc lamps burning very cheap natural gas. The luminous arc lamp so far surpasses any gas arc lamp in candle-power that, for spectacular work of this kind, gas arc lamps are left far in the rear. These luminous arc lamps are also coming into use to some extent for factory lighting in Cleveland.

Tungsten Lamps for Street Lighting.

An interesting street lighting installation, using series tungsten lamps, has recently been made at Grosse Point Farms, a suburb of Detroit. This lighting is done under contract by the Peninsular Electric Light Company, of Detroit, and for the particulars regarding it we are indebted to Mr. E. F. Philipps, in charge of the suburban properties of that company. As will be seen from Figs. 1 and 2, the latter a view of the street, the lamp post used has two goose-necks, each of which carries a radial wave reflector with a 16-cp, 5.5-ampere tungsten lamp. The length of the street so lighted is 11,500 ft., and there are 42 lamp posts placed at somewhat irregular distances apart, owing to the fact that some portions of the street have more trees than other portions and also because some portions are not as well built up as others. Where the roadway is straight and not built up as thickly, the distance between lamps is

greatest. The average distance between posts is 280 ft., although there are some places where they are 450 ft. to 500 ft. apart, and the company may some time be called upon to put in an extra post here and there.

The tungsten lamps are of the regular type for series street-lighting circuits made by the General Electric Company, and each lamp requires 5.5 amperes at a potential of 14.7 volts or 81 watts. The radial wave reflector is a fluted enameled steel reflector made for street lighting, and is of sufficient size to reflect in useful directions a large percentage of the light usually wasted above the horizontal.

FIG. I.—LAMP POST.

The street-lighting results obtained with this arrangement are excellent. On a visit by the writer to the street recently on a rainy night, it was noticed in one or two places where only one lamp was burning on each of two adjacent poles the lighting was still much better than is common on suburban streets.

The lamps are arranged in two circuits, and energy is supplied to them through No. 10 stranded single-conductor rubber and lead-covered cable from a constant-current tub transformer supplied from a 2300-volt single-phase circuit. The circuits are all underground. In the underground construction 3-in. fiber conduit was used. The trench for the conduit was dug just inside of the curb, to obviate the necessity of disturbing the roadway. An extra duct was laid in the trench with the street-lighting conduit to provide for any future call for commercial lighting on piers, boat-houses and grounds. The street thus lighted (Jefferson Avenue) is located along the lake front. In the conduit opposite each lamp post was located a brick hand-hole, with a cast-iron top 18 ins. in diameter. These hand-holes are 3 ft. from the lamp post. From the hand-holes a 36-in. 90-deg. pipe bend 2 ins. in diameter was run. Two-in. pipe was used for this bend because the slot in the base of the poles was not large enough to pass the 3-in. bend.

The illumination of this street is an excellent example of the economy obtainable in street lighting with tungsten lamps. Even better distribution of light would, of course, have been secured with twice as many posts, and with but one lamp on each post; but the construction expense would have been much greater. From an inspection of this street at night, it can be said safely that the majority of suburban streets would be lighted better than they are at present with poles located as far apart as they are in this instance and with but one 60-cp lamp per post. This would call for a very reasonable expenditure of power; only about 81 watts for every 280 ft. A part of the improved results obtained are due to the reflector employed, though, of course, the tungsten lamp is responsible for most of the improvement over existing methods.

FIG. 2.—JEFFERSON AVENUE, GROSSE POINT FARMS.

Main Street, Dayton, Ohio, at Night.

The accompanying engraving, made from a night photograph of Main Street, Dayton, Ohio, shows what the enterprising central-station interests there are doing to produce an attractive appearance on that city's principal down-town thoroughfares. Main is among the notably lighted streets for cities of this size. As will be seen, there is considerable sign and display lighting. Very rapid progress is being made in the introduction of sign and display effects in Dayton, and no doubt by the holidays the attractive appearance shown will even be improved. The Dayton Lighting Company has changed considerably the illumination of this street since the present ownership took hold.

MAIN STREET, DAYTON, OHIO, AT NIGHT.

Letter to the Editors.

Height of Lamps and Lighting Efficiency.

To the Editors of Electrical World:

Sirs:—It is a matter of common knowledge that the illumination obtained from a single lamp usually varies approximately inversely as the square of the distance. Even the most unscientific mind fully realizes that the nearer the reading page is held to the lamp, the more the light received on it. For this reason it may be somewhat difficult for those who have not watched recent illuminating engineering practice closely to realize that in some classes of lighting increasing the height of the lamps above the plane to be illuminated does not necessarily decrease the illumination. This is not due to any miraculous contravention of the law of inverse squares, but due to some long-unrecognized facts in connection with flux of light and reflection. In the case of a large interior like a store, where many lamps are giving light on the plane of the counters, it must be evident that the total light received on the plane of the counters is that coming directly from the lamps plus that which strikes the ceiling and walls and is reflected to the plane of the counters. Modern illuminating engineering practice would attempt, in a case of this kind, by the use of properly designed reflectors and reflecting surfaces, to throw as large a percentage of the total light generated by the lamps on the plane of the counters as is consistent with a well-lighted ceiling. A comparatively small percentage of the light given out is sufficient to light the ceilings and sidewalls, so that most of the light can safely be directed toward the plane of the counters.

Now if the lamps are hung low in very concentrating reflectors, each lamp will have a large percentage of its flux delivered over a small area under the lamp, and if there are sufficient lamps the entire area of the working plane will be covered.

If, now, these lamps be raised much higher than before, they will still have a large part of their light flux directed toward the working plane, but each lamp will cover a larger area. The total flux of light toward the counters being approximately the same, the illumination as measured on the counters would be the same, but with the difference that any given point on the counters would be receiving light from a greater number of lamps. Stated another way, the decrease in illumination due to the raising of any particular lamp is compensated for by the fact that the area lighted by that particular lamp will be also lighted by a number of other lamps when the lamps are raised from the lower to the higher position.

The correctness of this theory has now been well established by various tests. It is indeed fortunate that such is the case, for it permits of placing the light sources high out of the ordinary range of vision. This improves the apparent as well as the actual illumination, and in practice the apparent illumination to the casual observer is fully as important as the actual illumination in foot-candles measured by testing instruments. It is important to note, however, that unless proper reflectors are used which direct a large percentage of the light flux of the lamp toward the working plane under consideration, the height of the lamps has a great deal to do with the efficiency. The whole question simmers down to one of sending in useful directions a large proportion of the light coming from the lamp.

PHILADELPHIA, PA. CHAS. T. BLAKE.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Carbon Brushes.—An account of a very extended test of various commercial carbon brushes. Brushes of hard, medium-hard and soft carbon made by five different manufacturers were tested. The following properties were investigated: Apparent density, real denstiy, tensile strength, compressibility, wear and tear as a function of the speed, behavior as anode in electrolysis, specific electric resistance and its variation with a temperature, contact resistance and friction, content of ash, etc.; microscopic examinations of the carbons were also made. The values for the specific resistance in microhms-cm. vary between 8496 and 1494, while those for the temperature coefficient vary between —0.000842 and —0.000088.—*Bull. Soc. Internat. des Elec.*, August, September, October; abstracted in *L'Industrie Electrique*, Oct. 25.

Lamps and Lighting.

Incandescent Lamps.—TEICHMUELLER.—In different European countries there are now national bureaus for testing incandescent lamps. For these tests exact regulations have been formulated; for instance, in Germany by the buying bureau of the Association of Central Stations and by the selling bureau of the Syndicate of Lamp Manufacturers. A summary is given of the requirements in the different countries. Each lamp must be marked with the candle-power, the normal e. m. f. to produce this illumination (called the "test voltage"), and the mark A, B or C, where A means low specific power consumption and short life, B medium power consumption and medium life, and C high power consumption and long life. The useful life is 300 hours for A, 600 hours for B, and 800 hours for C. For instance, the mark 112 B 16 means a 16-cp, 112-volt lamp with a useful life of 600 hours. The e. m. f. for which the lamps are ordered ("the order voltage") may differ from the "test voltage" by the following amounts:

at 50 to 110 volt	± 2 volt
at 115 volt	+ 3 volt, − 2 volt
at 120 to 140 volt	± 3 volt
at 150 to 180 volt	± 4 volt
at 190 to 230 volt	± 5 volt
at 240 to 250 volt	+ 6 volt, − 5 volt

The above requirements are about the same in Germany, Austria and Switzerland. In England there are two standard e. m. f.'s, namely, 110 and 220 volts, and two standard figures for useful life, namely, 400 and 800 hours. For tests in Germany it is required that not more than 40 per cent of all lamps shall reach the limits given above for the voltage. However, for 5 per cent a further limit of 1 per cent is allowed. In Switzerland not more than 20 per cent of the lamps of each type and each size are permitted to reach the limits given above. Special figures are given for the specific power consumption required. For 16-cp lamps the figures are as follows:

	A	B	C
45 to 115 volts	2.69	3.12	3.44
116 to 155 volts	2.88	3.31	3.69
156 to 250 volts	3.06	3.56	3.94

The figures represent specific consumption in watts per hefner candle. It will be seen that for the higher supply voltages the lamps become less efficient, and that for the long-life lamps (C) a considerably higher power consumption is permitted. The specific power consumption is determined at the "test voltage." In Austria a discrepancy of 4 per cent from the above values is permitted, in Switzerland 6 per cent, in Germany from 5 to 8 per cent, according to the difference between the test e. m. f. and the order e. m. f. The corresponding table, which is valid in England, is also given. In Germany the specific consumption test is made with at least 30 lamps of each type, and, if the manufacturer desires, 2½ per cent of the whole shipment must be tested. The shipment may be refused if 10 per cent of the tested lamps do not fulfill the conditions; or if all the lamps were tested for candle-power and consumption, all those which do not fulfill the conditions may be refused. The useful life is defined as the life in which the candle-power decreases to 80 per cent of the candle-power marked on the lamp (not the real original candle-power). In the life test the lamps are used at the test voltage. The lamps are refused in Germany if 10 per cent of the tested lamps do not fulfill the life test; in Switzerland if 20 per cent of the tested lamps do not fulfill the conditions, and in Austria if two successive tests of 15 per cent do not fulfill the conditions. The lamp manufacturers complain that many of the conditions are too stringent. As the unit of light the mean horizontal candle-power is used in each case. In England there is the further requirement that the ratio of the mean spherical candle-power to the mean horizontal candle-power be at least 0.8.—*Elek. Zeit.*, Oct. 17.

Alternating-Current Arc Lamps.—J. SOHLMANN.—In order to render the operation of alternating-current arc lamps more economical, inductance coils instead of resistors should be used in series with them. Further advantages may be obtained by using a homogeneous carbon for the lower electrode and a cored carbon for the upper electrode. The e. m. f. of the lamp is thereby raised from 28 to 38 volts, and an apparent phase-difference occurs between current and e. m. f., due to the variable arc resistance, simultaneously with strong hissing. The author endeavors to flatten out the distorted current and e. m. f. curves by the use of the inductance coils so as to get a quiet arc. He states that his experiments were completely successful. On the assumption that in alternating-current arc lamps 40 per cent of the light thrown upwards is turned downwards by the reflector, the author finds the following figures for lamps consuming 360 watts, including the loss in the series resistor. A lower hemispherical candle-power of 490 hefner candles with one cored and one homogeneous carbon electrode and alternating-current, 332 hefner candles with two cored carbon electrodes and alternating-current, and 440 hefner candles with a cored and a homogeneous carbon electrode and direct current. —From *Tekn. Föreningens i Finland Förhandlingar*, 1906; abstracted in *Elek. Zeit.*, Nov. 7.

Flame Arc Lamp.—An illustrated description of a new modi-

fication of the "Juno" flame arc lamp made by a British company. The lamp is at present made in only one size, taking 450 watts and suitable for connecting four lamps in series on a 200-volt supply. The carbons, C_1, C_2, in Fig. 1, are clamped in holders attached to a cross slide, *S*, along which the holders can move as the convergence of the carbons requires. One carbon always rests at its lower end on an abutment piece, *A*, so that as it burns away the two electrodes are caused to descend by gravity together with the cross slide. The abutment piece is simply a bent copper bar, which has to be renewed through burning away only once every three months or so. The magnet for striking the arc is placed at the top of the case. A rod, *W*, attached to its armature rests upon a projection of the striking lever, *F*. When the lamp is not burning, the

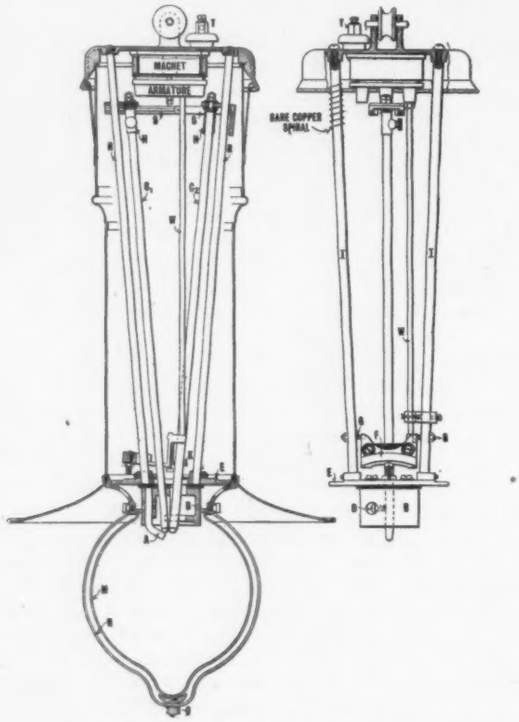


FIG. I.—FLAME ARC LAMP.

weight of the armature and rod keeps the striker in the position shown, and the collar, *K*, attached to it keeps the carbons pressed together. When the circuit is completed, the armature is attracted, and the weighted striking lever moves and causes the carbons to separate, thus starting the arc. The necessary magnetic flux to "blow out" the arc is obtained by means of the two iron side rods, *I*, which are wound with a helix of wire carrying the main current. With the type of carbon without a metal case recommended for these lamps, it is claimed that practically no fumes are given off and remarkably little ash is found in the globe.—Lond. *Elec. Eng'ing*, Nov. 7.

Luminescence.—E. L. Nichols and E. Merritt.—The eighth paper of their serial on studies in luminescence. The present paper deals with the influence of the red and infra-red rays upon the photoluminescence of Sidot blende.—*Phy. Rev.*, Nov.

Power.

Electric Power Along a Canal.—L. Pasching.—An illustrated article on the electricity plants of the Rheintalishe Binnenkanal in Switzerland. Three water powers were available with distances of about 3 miles between two succeeding ones. In view of the location of the three water powers with respect to the area to be supplied with energy it was not possible to let each station supply energy to its own area. On the other hand, operation in parallel of three distant plants was somewhat difficult. It was then decided to use the following novel system. Only one plant was equipped with synchronous generators, while the two other plants were equipped with non-synchronous generators; that is, induction motors running above synchronism. The first cost of this system is less than for three synchronous generator stations, while the cost of operation is very much less, since no skilled labor is required in the two stations equipped with non-synchronous generators. The operation is quite satisfactory.—*Elek. Zeit.*, Oct. 17 and 24.

Water Power in Italy.—An illustrated article on the utilization of water power for industrial purposes in central Italy. The Abruzzi Mountains, which was one of the most primitive regions in Italy hardly a generation ago, has now become an industrial center with many electric lighting and power plants. This is due to the abundance of water power. Various electrochemical and electrometallurgical plants are in this region.—Lond. *Electrical Review*, Nov. 8.

Rhine.—J. Reyval.—An article, illustrated by maps, on the water power available along the River Rhine in Switzerland.—*L'Eclairage Elec.*, Oct. 5.

Electric Equipment of Flour Mill.—W. O. Horsnaill.—An illustrated description of the equipment of a flour mill which is partly electrically driven, although rope-driving has been adopted for such parts of the mill as contain continuously running interdependent machinery.—Lond. *Elec. Eng'ing*, Nov. 7.

Electric Power in Mines.—Notes on the general introduction of electric working in mines in New South Wales, where the more advanced collieries are adopting electric power. Opposition has been made from the miners, and has assumed the form of strikes or threatened strikes. Some notes are given on the prevention of explosions.—*Australian Mining Standard*, Oct. 2; abstracted in Lond. *Elec. Eng'ing*, Nov. 7.

Internal Combustion Engines.—The full issue is devoted to articles on internal combustion engines. H. H. Suplee gives a historical review of the development of the internal combustion engine; B. H. Thwaite discusses the blast furnace as a center of power production; E. F. Adams the development of the large gas engine in America; H. A. Humphrey by-product recovery gas-producer plants; L. Greiner the utilization of the waste gases of blast furnaces and of coke ovens in metallurgical works; C. T. Wilkinson, the utilization of low-grade fuels in the gas producer; F. E. Junge, the gas-power situation in Germany; G. M. S. Tait, producer gas composition and its influence on the performance of suction-producer plants; W. H. Booth, large gas and steam engines; F. J. Rowan, the suction-gas producer; E. A. Harvey, the production of engine gas from bituminous coal, and C. E. Lucke, energy transmission by producer gas. The portrait of Dr. N. A, Otto is given as frontispiece.—*Cassier's Magazine*, November.

Gas Power.—An article with reference to a recent paper by Mathot on modern gas producer and gas engine practice.—Lond. *Electrical Review*, Nov. 8.

Smoke Nuisance.—An account of a recent London police court prosecution of the Westminster City Council against the Underground Electric Railways Company of London for causing a nuisance by emitting black smoke from its power house. The case has been decided in favor of the company. The magistrate held that the smoke was brown and not black, and that all reasonable care was exercised by the company to prevent any nuisance.—Lond. *Elec. Eng'ing*, Nov. 7.

Installations, Systems and Appliances.

Earthing the Neutral Point.—E. V. Shaw.—The neutral of a three-phase system should be earthed at one point only, and that through a suitable resistance. In a large power station containing a number of three-phase machines running in parallel, only one should be earthed in its neutral point. The author has devised an automatic switch for this purpose. This automatic earth switch, shown in Fig. 2, is made up of two parts—the earth switch proper and the supplementary or motor-control switch by which it is operated. The earth switch itself consists of a slate base, on which are mounted one ring contact—which is connected directly to the earth resistor—and, concentrically with this, the same number of contacts as there are machines in the station, each of these contacts being connected to the neutral point of one machine. A brush carried on a shaft connects this ring to one contact at a time; this is coupled by worm-gearing to a 1-hp motor, which is capable of revolv-

ing the brush at the rate of 2 r. p. m. The supplementary switch is similar to the main switch, but is much lighter in construction; its revolving brush is carried on the same shaft as the main brush, and these two brushes are on the opposite ends of the shaft, which is geared in the middle to the motor. The ring contact of this supplementary switch is connected to the

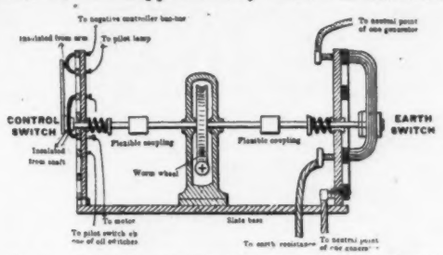


FIG. 2.—GENERAL ARRANGEMENT OF EARTH SWITCH.

negative side of the switch motor, and each of the small contacts corresponding to the neutral point contacts on the earth switch, is connected to the "off position" of the pilot switch on the main oil switch for that generator. (Fig. 3.) It will be seen that while the earth switch is connecting the neutral point of a generator, which is switched on to the bus-bars to earth, the motor circuit is broken at the pilot switch, but immediately the oil switch of this generator is opened the pilot switch comes over to the "off position" and closes the motor circuit. The motor then drives the revolving brushes until the main brush connects the neutral point of the next machine, which is switched on to the bus-bars, to earth. When it reaches this

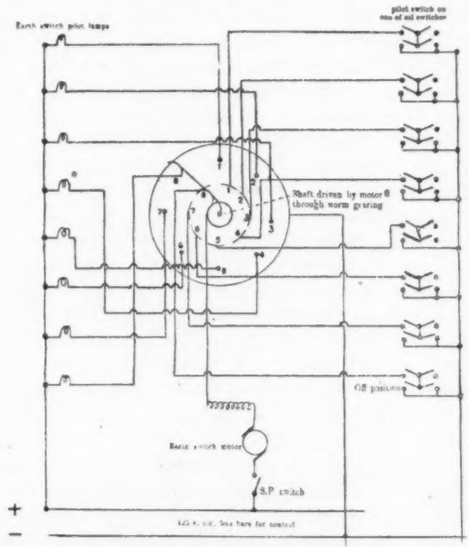


FIG. 3.—CONNECTIONS OF MOTOR CONTROL SWITCH.

position, the brush on the supplementary switch being in a corresponding position, the motor circuit is now opened at the pilot switch on the oil switch of this generator. It is arranged for the earth switch to travel in a clockwise direction. The small single-pole switch in the motor circuit is provided for opening this circuit when all the generators are off the bus-bars, so as to prevent the motor from driving the switch round and round, searching for a generator to earth. In addition to this, on a particular switch designed by the author, a pilot switch has been added similar in construction to the motor-control switch, the brush arm of this switch being likewise driven by the common shaft. This is shown in the two illustrations. This pilot switch closes the circuit for the "earth-switch pilot lamp" corresponding to the generator which is earthed.—Lond. *Elec. Review*, Oct. 18.

Three-Wire Direct-Current System.—W. A. TOPPIN.—An article in which the author states that in Great Britain out of a total number of 428 central stations, 280 distribute by means of the three-wire system, 81 stations by means of two-wire direct current, and only 67 give a purely alternating-current supply. The majority of the two-wire direct-current stations will change over to the three-wire system as they increase in size. The author describes a method of L. R. Lee for locating faults. The only apparatus required is a voltmeter and a coil of lightly insulated small wire.[1] The most suitable voltmeter is a very sensitive one, having two scales, one reading from 0.01 to 1 volt and the other 1 to 100 volts. One terminal of the voltmeter is connected to as good an earth as can be obtained; there is generally a terminal connected to an earth plate in each feeder and distributing pillar. A water-pipe or even a gas-pipe has been found to give excellent results. The other terminal of the voltmeter is connected to a screwdriver or metal plate. The earth in the vicinity of the fault is raised to a pressure above the normal, and it is this pressure that it is desired to measure. The fault will be found immediately below the spot where the highest reading is obtained. As it is essential that the leakage should be taking place during the test, it is advisable to have four lamps in series across the outers, with the middle point earthed; these can be connected up at the nearest pillar, and thus save the rouble of telephonic inquiries to the station.—Lond. *Electrical Review*, Oct. 25.

Circuit-Interrupting Devices.—F. W. HARRIS.—The first of a serial of articles on switches, fuses and circuit-breakers. The author discusses the general appearance of their design. Fig. 4

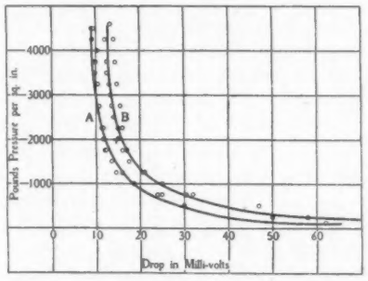


FIG. 4.—CURVES OF VOLTAGE DROP.

shows typical curves of voltage drop between two contacts, the current being maintained constant and the pressure varied. The drop across the contacts decreases rapidly with pressure up to a certain critical pressure. To prevent an arc in interruping a circuit it is necessary to prevent the formation of low-resistance vapor or to successfully counteract its effect. To extinguish arcs, four commercial methods are used: Oil magnetic blow-out, expulsion and enclosure. Finally, the quickness of break is discussed.—*Electrical Journal*, November.

Electricity Supply Development.—An illustrated article on the development of the electricity supply undertaking of the St. Marylebone Borough Council, which is the largest municipal system in London. It was one of the first to apply organized methods to the commercial development of the business. The publicity department has done considerable work. A very complete system of curves and book records of the progress of the undertaking is kept up by the department. Slot meters are in use, but at present no free wiring or higher schemes are in operation, though they are being contemplated.—Lond. *Electrical Review*, Oct. 25.

Sub-Stations.—IDELBERGER.—The first part of a description of the sub-station Krummestrasse of the Berlin electric elevated and subway. It is supplied with three-phase currents, which are changed in five 660-kw converters to direct current. The article is profusely illustrated.—*Elek. Zeit.*, Oct. 31, Nov. 7.

Berlin.—K. WILKENS.—The conclusion of his long illustrated article on the Berlin Electricity Works at the beginning of 1907. The concluding installment deals with the storage battery equipment.—*Elek. Zeit.*, Oct. 24.

Wires, Wiring and Conduits.

Losses in Alternating-Current Cables.—E. STIRNIMANN.—In tests of large alternating-current cables the ratio of the apparent alternating-current resistance to the calculated direct-current resistance was found in several cases as high as two or three. The large additional resistance cannot be explained by the ordi-

nary skin effect. Although self-induction may account for part of the increased apparent resistance, there is still another cause. An ordinary stranded cable consists of a central wire around which one or more layers of smaller wires are laid spirally. The current has two ways open to itself, first, along the spiral-wound conductors, and, secondly, in straight direction passing from one wire to the next. The first path has resistance and inductance. The second path has only ohmic resistance. This explanation was found, indeed, to be satisfactory. The conclusions arrived at by the author are that for normal alternating-current systems ordinary cables can be safely used up to cross-sections of 100 sq. mm, but above this the cables should be sub-divided into a number of segmental or circular cables, insulated lightly from one another, and stranded together, and of not more than 70 sq. mm section each. "Specifications for alternating-current cables should also contain a clause fixing the conductivity for alternating current at, say, 95 per cent for 50 cycles, and 98 per cent for 30 cycles or less—the latter being the ordinary direct-current specification."—Lond. *Elec. Review,* Oct. 11.

Determining Voltage Drop.—T. L. Kolkin.—An illustrated article giving graphical methods for determining the voltage drop in energy distribution systems.—Lond. *Elec. Review,* Oct. 11.

Electrophysics and Magnetism.

Spark Potentials.—P. Pringsheim.—The results of Roentgen, Precht, Tamm, Evers, Warburg and others with respect to spark potentials are greatly at variance, often differing by 1000 volts. The present author points out that results equally variable can be obtained with one and the same apparatus. They apparently depend upon a number of imperfectly known conditions. One of these conditions is, no doubt, the temperature of the spark-gap and terminals, and this the author subjects to a careful scrutiny, using a gold cylinder and a platinum point charged to a positive or negative potential. The whole spark-gap and leads were heated by an electric oven. The author found that the negative minimum potential is inconsistent when the point is new, but soon acquires a constant value which returns on returning to the original conditions of temperature, illumination, etc. By heating to a red heat under constant density, the negative minimum potential is reduced to an amount which suffers no further reduction on heating further. The positive spark potential is affected only slightly by heat. The current density increases rapidly on heating the negative point above 500 deg. C. The phenomena are qualitatively the same in air as in nitrogen.—*Ann. d. Physik.,* No. 11; abstracted in Lond. *Elec. Eng'ing,* Nov. 7.

Electrochemistry and Batteries.

Disinfection.—At Poplar the Hermite electrolytic process of making hypochlorite is in use. Formerly carbolic fluid and powder disinfectants were used. It is shown that the use of the electrolytic hypochlorite disinfectant has reduced the cost to about one-half, and that this saving has already paid for the initial outlay for the plant. In the future a still greater saving is expected, since the system is now in working order, and the expenditure for wages, batteries, etc., will be smaller.—Lond. *Electrician,* Nov. 8.

Induction Furnace.—V. Englehardt.—The first two parts of a long illustrated serial on electric induction furnaces and their application in the iron and steel industry.—*Elek. Zeit.,* Oct. 31, Nov. 7.

Electrometallurgy.—J. B. C. Kershaw.—An illustrated summary of some recent developments in the electrometallurgy of ferro-alloys, steel, lead, tin and zinc.—*Eng'ing Magazine,* November.

Units, Measurements and Instruments.

Measuring Iron Losses.—J. Sahulka.—A paper read before the German Association of Electrical Engineers on a method of determining the iron losses as a function of the induced maximum flux. The body of iron to be tested is indicated by *E* in Fig. 5. The losses are measured by means of the wattmeter *W*, the effective value of the alternating current which magnetizes the iron core *E*, is measured by means of the ammeter *A*. The voltmeter *V*, serves for controlling the e. m. f. of the alternator, which supplies the energy. By means of the switch *U*, it is possible to connect the magnetizing windings of *E*, the ammeter *A* and the current coil of the wattmeter *W*, either with the alternator or with a Wheatstone bridge. In this way it is possible to measure first the iron losses and then to determine immediately afterward the resistance of the circuit, so that the copper losses may be found and deducted from the loss determined with the wattmeter. During the resistance

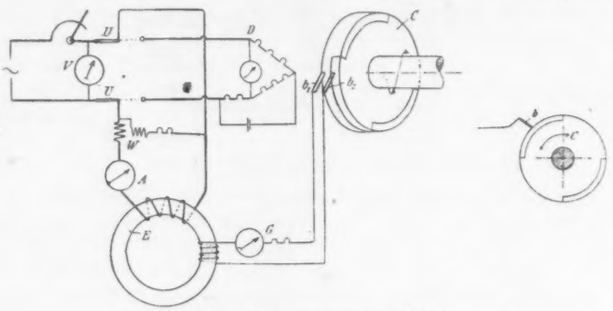


FIG. 5.—MEASURING IRON LOSSES.

measurement the voltage-coil circuit of the wattmeter must be open. For testing the field in the core *E* a secondary coil is provided, which is connected to the galvanometer *G*, and a contact device, *C*. The latter is placed either directly on the axle of the alternator or on the axle of a synchronous motor. The contact device operates so that the galvanometer circuit is closed during one half period and open during the next half period. There are two brushes, b_1 b_2, of which b_1 slides on a complete circular brass ring. On the other hand, the brush b_2 slides on a disc constructed as shown in the right-hand diagram. This disc is made of hard rubber and has two sectors of copper inserted on the surface at opposite places as shown in the diagram. These copper sectors are firmly connected with the complete copper ring of the other disc. In order to obtain good results it is very important that the brushes do not vibrate and that the contact surface is clean. Under proper conditions the needle of the milliammeter *G* does not vibrate in any way. The indication of this needle gives the current which, when multiplied with a constant value, gives the flux in *E*. If the object is to determine the iron losses as a function of the maximum flux, the position of the brushes must be so adjusted that the deflection of the galvanometer *G* becomes a maximum. The results of a test of a certain kind of iron are given. In this case it was found that with constant flux the hysteresis loss per period increased with increasing frequency. A special arrangement for testing sheet steel is also described.—*Elek. Zeit.,* Oct. 10; *Elek. und Masch.,* Oct. 20.

Variable Mutual Inductances.—A. Campbell.—An abstract of a (British) Physical Society paper on the use of variable mutual conductances. In connection with wireless telegraphy the measurement of small inductances and capacities is of importance; one of the methods described has special reference to small self-inductances. Mutual inductances can be more easily dealt with than self-inductances, for the former can be (1) more accurately calculated from dimensions, (2) are less affected by change of frequency, and (3) when variable, can be made to pass through zero value. A convenient form of variable mutual inductance consists of a continuously variable part and a series of steps. The first consists of two equal parallel coils with a third coil moving parallel to their planes round an axis eccentric to the fixed coils. The scale thus obtained is very open near zero (which is an advantage) and the graduation is done by experiment. The steps are obtained by means of another fixed coil of standard wire, each strand giving an equal sub-division. The model shown had two ranges, from 0.01 to 200 and 2000 microhenries. A variable mutual inductance of this type has a number of applications. It is obviously convenient for calibrating ballistic galvanometers. By means of it mutual inductances of all values can be readily measured.

By several methods it can be used to measure capacities, and the formulas required are mostly very simple. Its most important application, however, appears to be the measurement of small self-inductances as follows: Let the variable mutual inductance be called W. With a source of intermittent or alternating current and any convenient detector (vibration galvanometer, telephone, etc.), a bridge with corners, A, B, C, D, is formed, in which BD and DC are equal non-inductive arms, AB is the fixed secondary of W and AC has resistance and self-inductance equal to those in AB. The detector is across BD, while the source is applied at D and also through the primary of W connected to A. When W is set to zero reading a balance is obtained. An unknown self-inductance, N, is now inserted in AC, and the balance restored by adding resistance in AB and adjusting the mutual inductance W. The reading of W when doubled gives directly the value of the unknown N. The method is really a differential one and can also be used to give very accurate measurements of the difference between two nearly equal large self-inductances.—Lond. *Electrician,* Nov. 8.

Measuring Insulation Resistance.—D. SHIRT.—An illustrated description of a method of testing direct-current networks for insulation resistance during working. It may be applied with advantage to the neutral of a three-wire or a five-wire system, because the earth connection need not be interrupted. It is customary in many generating stations to make the resistance of the neutral earth connection as small as possible, but to provide some means of introducing a known resistance, either by means of a switch, which normally short-circuits it, or by means of a rheostat, so that, in the event of a fault occurring on one of the "outers," the "leakage" current may be controlled. The test consists simply in measuring the leakage current through the earth connection for two different values of the resistance of the latter. If these resistances are R_1 and R_2 ohms, and if the corresponding leakage current is I_1 and I_2, then the insulation of the system to earth in ohms is $(I_2R_2 - I_1R_1) \div (I_1 - I_2)$. It is convenient to let R_1 be the normal resistance of the earth connection and it may in some cases be so small as to be negligible.—Lond. *Elec. Review,* Oct. 11.

Sensitiveness of Photometers.—L. W. WILD.—An account of some experiments in which the author endeavored to determine comparative figures for the sensitiveness of photometers. Eleven different photometers were tested, and different sources of light were used so as to determine the effect of difference in color. On sources giving the same color of light, flicker photometers are not so good as the best of stationary photometers, but as soon as the color difference is at all appreciable, such as is met with even in the photometry of carbon-filament lamps, against a carbon-filament standard, both of the flicker photometers tested were found superior in sensitiveness to any other form of photometer.—Lond. *Electrician,* Nov. 8.

Magnetic Tests.—E. HAUPT.—An illustrated description of a magnetometer for iron tests, which is not disturbed by external magnetic fields. It is specially suitable for making magnetic tests of short and thin pieces of iron, such as relay armatures and other small iron pieces of telegraph apparatus.—*Elek. Zeit.,* Oct. 31.

Testing Machine.—C. E. LARARD.—A paper read before the (British) Institution of Mechanical Engineers on a new single-lever testing machine and some torsion tests. The special feature is the good control which is obtained by electrical means. This method is described and illustrated.—Lond. *Electrician,* Nov. 8.

Telegraphy, Telephony and Signals.

Wireless Telephony.—C. SCHAPIRA AND S. LOEWE.—An illustrated description of a method of wireless telephony used by a German company and stated to give satisfactory results in practice over a distance of from 18 to 24 miles. While Poulsen uses the Duddell arrangement of a capacity-inductance circuit in shunt with an arc burning in an atmosphere of hydrogen and in a strong magnetic field with artificially cooled electrodes, the present method employs neither a hydrogen atmosphere nor a magnetic field. The fundamental feature is a multiply-subdivided arc lamp, the arc occurring between two electrodes of the form shown in Fig. 6, where A is a solid carbon electrode (30 mm in diameter), and B is a hollow copper electrode filled with water (45 mm diameter). Six such arcs are used in series on a 220-volt supply and 12 on a 440-volt supply. When the arcs have been lighted by removing one set of the electrodes from the other set by means of a common lever, further regu-

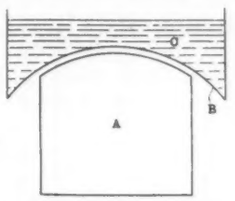
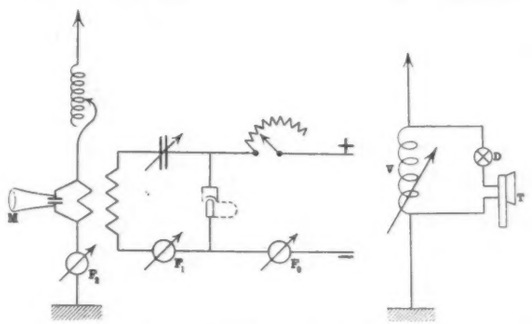


FIG. 6.—WIRELESS TELEPHONY.

lation is unnecessary, since the rate of burning of the carbon is very trifling. The cooling water must be renewed at intervals of from eight to ten hours. The transmitting apparatus is shown in Fig. 7. In accordance with the alterations of the resistance of the microphone there will be variations of the coupling and of the tuning of both of the circuits and corre-



FIGS. 7 AND 8.—WIRELESS TELEPHONY.

spondingly of the energy output from the antenna. F_2 is a hot wire ammeter included in the antenna circuit; this instrument shows how the output of the radiation from the antenna is effected by speaking into the microphone. The receiving apparatus is shown in Fig. 8, where V is a variable self-induction in shunt with the detector D and the telephone T.—Lond. *Elec. Eng'ing,* Nov. 7.

Miscellaneous.

Electrostatic Separation.—F. ESSER.—An account of an experimental investigation of the possibilities of electrostatic ore separation. This is found to be applicable with good success only when the ore has been reduced to particles of a size between certain limits. Sizes downward from 1 mm to a certain minimum were found most suitable; above 1 mm the results were less satisfactory, while the finest powder could not be separated electrostatically. To be successful, it is necessary that all of the particles to be separated consist of the same material; any impregnation with foreign materials acts as a disturbing factor. For instance, an ore in which zinc blende is very intimately united or impregnated with pyrite is not suitable for electrostatic separation. Thus zinc blendes, which are poor in iron, are most suitable. These conclusions are valid only for countries with the same climate as Germany. In districts high above sea level and with a dry climate, as in Chili and Colombia, the conditions are much more favorable to electrostatic separation—*Metalurgie,* Sept. 8 and 22; abstracted in *Electrochem. and Met. Ind.,* November.

Teaching.—A. SCHWARTZ.—An address to technical teachers with the title "The New Technology." The author emphasizes that the aim of the school should be to impart a thorough understanding of the principles underlying the branch of technology concerned, to inculcate habits of observation and logical thought, and to train the student in the lines of thought and modes of attack employed in mathematics, physics, chemistry, engineering or other technological subjects, and in the interpre-

tation of results. The method of teaching should be rather by experience than by facts. It is all wrong to give the student a certain number of concentrated doses of pre-digested information. Further, there should be some curtailment of the method of examination. Some notes are given on what can be done in day courses and evening courses.—Lond. *Electrician*, Nov. 8.

BOOK REVIEWS.

Mathematical Handbook. By Prof. Edwin P. Seaver. New York: McGraw Publishing Company. 279 pages. Price, $2.50 net.

This book is intended solely for reference, various formulas being given without explanation as to their derivation. It contains the chief formulas of algebra, trignometry, circular and hyperbolic functions, differential and integral calculus, and analytical geometry, together with mathematical tables. The tables comprise the squares and cubes of numbers up to 1000; the square-root and cube-root of these numbers to the seventh decimal place, and the cube-root of the square and the reciprocal of the same numbers to the seventh significant figure. The tables of logarithms relate to numbers up to 999, logarithms to base 10 being expressed in five figures, and those to base ϵ being carried to the third significant figure of the number itself. Tables are also given of circular and hyperbolic functions, and the logarithms of the values. An unusual table is one relating to the velocity of bodies falling from various heights. The book is of convenient size, 5 in. x 8 in., and contains a large amount of information in compact form for ready reference by the mathematician and engineer.

Harper's Electricity Book for Boys. By Joseph H. Adams and Joseph B. Baker. New York: Harper & Brothers. Illustrated, 407 pages.

This is one of a series of practical handy books for the rising generation, and is destined to have a very wide circulation. It is distinctly of the "How to Make" character, not the least merit being the extremely clear and precise drawings of parts and details of all the classes of electrical apparatus it includes. This is an electrical age, and a great many boys of inquiring minds and of mechanical ability will find immense usefulness in the simple, straightforward instructions of this volume. In fact, the book may well be employed as a test of youthful enthusiasm. Lots of boys think they would like to be electricians, and pictures of themselves as future "wizards" float hazily before their minds. But the very first application of reality, the very first effort to read a serious book on the subject, or work out a circuit or a piece of apparatus, puts the novice "out of business." The boy who goes through this admirable book with vim and zest stands an excellent chance of making a good electrical engineer in the long run. We commend it at this season to every anxious, forecasting parent.

The greatest part of the book is due to Mr. Adams, the last chapter, on the uses of electricity all around us, having been added by Mr. Baker. It will be succeeded by a companion book of slightly advanced, yet popular nature, "How to Understand Electrical Work."

Electric Railways. Vol. II. Engineering Preliminaries and Direct-Current Sub-Stations. By Sydney W. Ashe. New York: D. Van Nostrand Company. 282 pages, 145 illustrations. Price, $2.50.

The treatment employed in this book is both theoretical and practical. There are ten chapters dealing with preliminary considerations concerning the probable income from passengers, determination of the required motor equipment, schedule and load diagrams, power house and sub-station location, rotary converter sub-stations, the rotary converter, the transformer, insulating oils, and auxiliary sub-station apparatus. With the exception of the part dealing with the so-called "electrical features" connected with the selection of the motor equipment, the matter is largely descriptive of present practice, the information having been compiled from various sources.

The book suffers from a lack of consistent editing. For example, no attempt seems to have been made to render the symbols uniform throughout. Thus, V is used both for e. m. f. and for speed; speed, however, is also represented by S, while S is used for distance, and distance is denoted by D, and also by L. In view of the strong intimation on page 225 that transformers can be used only when connected either "delta" or "mesh," one is not surprised to find on page 224 an illustration of a partially completed one-phase, shell-type transformer designated as the "core of a three-phase transformer." Probably the lack of care in details is the cause for the statements on page 219 that the "drop in the transformer coils" is I^2R, and that eddy currents depend upon the "reluctivity" of the iron, and the intimation on page 217 that the losses in a transformer may sometimes be considered as "negative." By far the best part of the book is found in chapters II, III and IV on "Electrical Features," which contains much useful information presented in a logical manner. In fact, it may be stated that the intrinsic value of these chapters is sufficient to counterbalance the errors of carelessness found elsewhere in the book.

Relay Type of Recording Meter.

By M. C. Rypinski and H. W. Young.

There are in general use two types of recording meters, which may be designated as the "direct-swing" type, in which the recording pen is directly actuated by the measuring element, and the "relay" type, in which the recording pen is actuated or driven by a separate source of power, the measuring element simply opening and closing a local circuit. In external appearance, commercial relay recording wattmeters, voltmeters, ammeters, frequency meters and power-factor meters differ immaterially. Moreover, the operating principles are very similar. The quantity being measured tends to move a dynamometer arm in a certain direction. The movement is opposed by a spring whose tension likewise depends upon the quantity being measured. When the arm is in an equilibrium position, the elongation of the spring is an indication of the quantity.

The principle of operation can readily be described in connection with the circuit diagram of Fig. 2, which relates to a recording voltmeter. The various elements of the meter are designated as follows: A, B, C, D, fixed coils; E, F, movable coils mounted on supporting structure pivoted at G; G, pivoted support of E, F; H, upper adjustable relay contact connected to L; I, lower adjustable relay contact connected to K; J, movable relay contact attached to movable element E-F; K, pen actuating electromagnet (left hand); K' iron core of K; L, pen actuating electromagnet (right hand); L', iron core of L; M, arm supporting iron cores pivoted at N and connected to O by pin bearing P; N, pivoted bearing for M; O, pen arm connected to M by pin bearing P, and provided with guide slot at the upper end, which bears on stationary guide pin R; P, pin bearing connecting M and O; R, stationary guide pin for O; S, recording pen arranged to pass across a suitable moving record paper, T; U, helical spring connecting movable coil system and movable pivoted supporting arm, M.

The meter operates upon the Kelvin balance principle, combined with a modified form of the "Siemens dynamometer" control. The coils are so arranged that when current exists in them the left-hand coil, E, is repelled by A and attracted by B, the right-hand coil, F, being repelled by D and attracted by C. Assuming the recording pen to be at the zero position on the chart and connection made to the relay and the measuring circuits, it will be seen that the movable system will take up a position which will force contact J against contact I. A circuit will thus be completed through the right-hand solenoid, L, and the electromagnetic attraction will cause the core L' to move downward, which movement will turn M about its axis and through its connection with O cause the pen to move across the chart toward the full-scale position. This movement of M places tension on the spring, U, and continues increasing this tension until the core has traveled a sufficient distance to place

such a tension on U that it balances the torque of the movable measuring system, E-F, and draws the contact, J, away from I. The entire moving system, including the solenoids, pen arm and measuring coils, remains in the position last assumed when the circuit was broken and the pen continues to draw a line which represents the voltage of the circuit.

It will be noted that the spring U is now under tension, and the position of the contact J between contacts H and I represents a balance, or state of equilibrium, between the actuating and restraining forces. This can readily be compared to the action of a Siemens dynamometer in which the knurled thumb nut has been turned until the torsion of the control spring has drawn the pointer attached to the movable coils back to zero and the pointer operated by the knurled thumb nut will indicate the circuit voltage. The zero reading pointer of the dynamometer can thus be likened to the movable contact J of the recording meter and the manually operated pointer of the dynamometer may be likened to the solenoid operated pen of the recording meter. It will be seen, therefore, that the manual operation of the dynamometer's indicating pointer is replaced by electrical operation of the graphic meter's recording pointer.

If the voltage increases, the movable contact is again deflected downward until it makes contact with the lower fixed contact and the right-hand solenoid again causes the recording pen to move across the chart until the increased tension of the spring balances the increased torque of the measuring element, drawing the movable contact J away from I and again opening the solenoid circuit. The recording system again remains stationary until the voltage of the supply circuit changes.

If the voltage decreases the contact J rises and making contact with H energizes the left-hand solenoid, K, which, drawing down its core, causes the pen to move down the scale toward zero, and as this movement continues the arm, M, moves up sufficiently to relieve the tension on U and restore the balance between the actuating forces of the measuring system and the spring, when the contact, J, will leave H and open the control circuit through K.

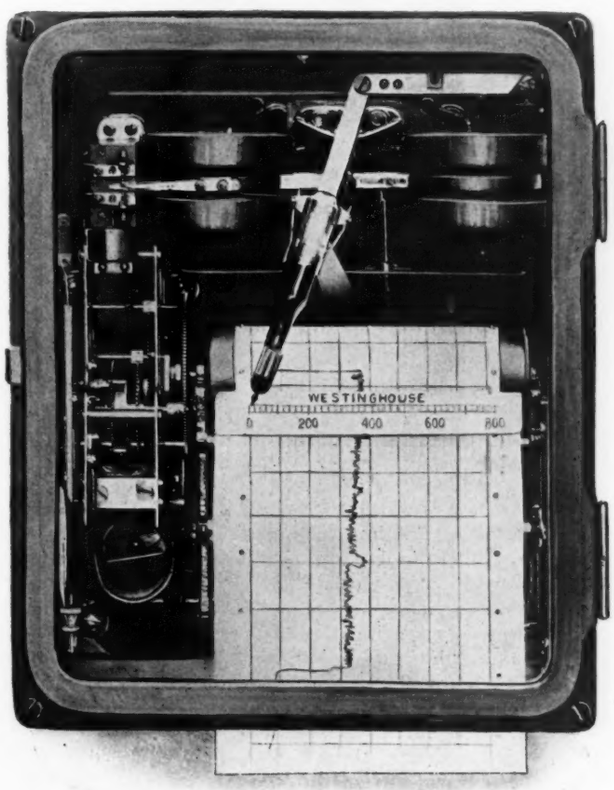
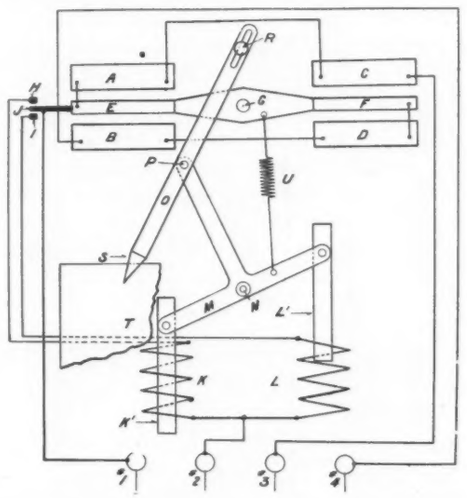


FIG. I.—ELECTRICAL AND MECHANICAL DEVICES OF RECORDING METER.

It will thus be seen that as the voltage varies the contact J moves up and down, completing the circuit through one or the other control solenoids, causing the recording pen to move across the chart, and this gives a record of the variations.

The sensibility and damping can be altered readily to suit local conditions; for instance, on a badly fluctuating voltage, in order to obtain satisfactory records, it would be necessary to employ a meter of different damping period than on a circuit on which the voltage was constant. Attached to the moving coils is a piston suspended in a small dash pot, and this dampens the movement of the moving system by absorbing its excess momentum. The magnitude of this action is variable by changing the oil density, a heavy oil giving greater damping and *vice versa*.



CIRCUIT DIAGRAM OF RELAY TYPE OF RECORDING VOLTMETER.

By varying the distance between the contacts H and I, the sensibility may be controlled. When the contacts are close together, the slightest variation in the voltage will be recorded, giving, in some cases, a very irregular line. By increasing the space between the contacts, the meter will not record such small changes and the curve will be more regular, but large variations will be recorded with equal accuracy.

The quickness of action can be controlled by the adjustment of the main dash-pot pistons. Cylinders are provided having an adjustable leakage slot, and by increasing the width of this slot the pen action may be quickened. For extreme slowness, on badly flucuating e. m. f.'s, a heavier oil may be used, and where a quick response to change is desired a light grade of oil will give the desired result.

The recording pen is constructed of glass so formed as to provide an ink reservoir of such size that one filling suffices for several months' use. The pen-point is drawn to a capillary tube of heavy wall and small bore, giving maximum strength with minimum width of line.

A specially calendered and ruled grade of paper is used and furnished in rolls of 244 ft. in length, being sufficient for two months' use at a speed of 2 ins. per hour, or a proportionately shorter time at 4 ins. or 8 ins. per hour. The paper is ruled longitudinally with a set of parallel lines, which represent the meter calibration, this ruling varying with the different types and ratings. At right-angles to the calibration lines are a set of parallel lines representing hours, varying in distance from each other with the particular rate of speed for which the paper is ruled.

The clock mechanism which drives the paper is of the electrically-wound pendulum type. It moves the paper under the recording pen at a uniform predetermined rate, synchronous with the time markings on the recording paper. Its electrically winding mechanism is operated from the same circuit as the pen-actuating electromagnets and it winds at intervals of one hour.

Gas Producer Generating Station of the Milwaukee Northern Railway.

A feature of the equipment of the Milwaukee Northern Railway which has attracted especial attention from the engineering public and users of electrical energy is the fact that the motive power of the road is furnished by gas-engine-driven electric generating units of a size heretofore unknown to the traction interests of this country.

The location of the main power plant is at Port Washington, on the harbor front, where the handling of coal is very economical and convenient. Two buildings comprise the power plant proper, one for the producers and one for the engines, generators, switchboards and protective apparatus. The gas supply main is run outside of and along the entire length of the power house from the producer plant.

The generating units are three in number, each of 1000 kilowatt rating, two of which are now installed; the third will be set up shortly. Each unit consists of a twin-tandem horizontal double-acting Allis-Chalmers gas engine direct connected to a 405-volt, 25-cycle Allis-Chalmers alternator. Although the rating of each unit is given as 1000 kilowatts, both engine and generator were designed with large overload margin, the engine being capable of developing upwards of 2000 horsepower and the generator having a corresponding overload range. Each engine has four cylinders, 32 ins. in diameter by 42 ins. stroke, and operates at 107 r. p. m.

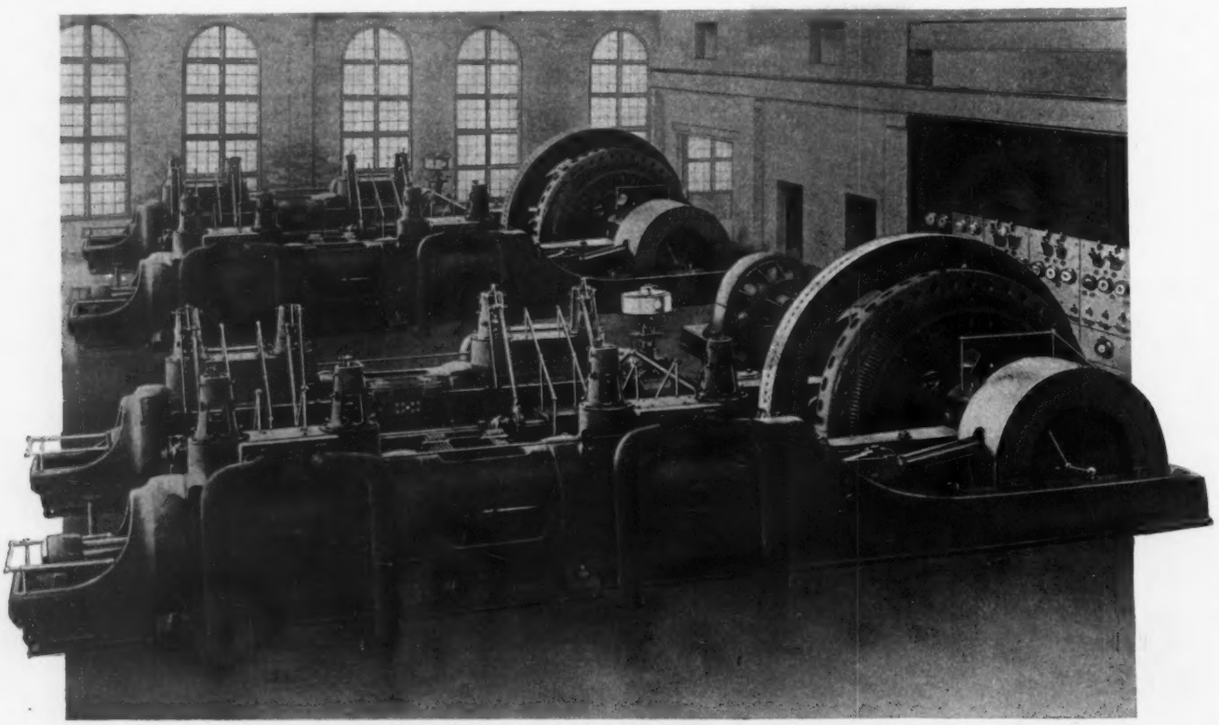


FIG. 1.—VIEW OF GAS ENGINES AND GENERATORS, POWER HOUSE, PORT WASHINGTON, WIS.

The valve gear is of the standard Allis-Chalmers cut-off type, and the engine operates with constant compression, thus tending to insure smooth running under the highly variable loads to which it is subjected. The inlet gear is extremely simple, consisting of a main inlet valve of the single-beat poppet type, eccentric operated, thus insuring long life and quiet running. The mixture of the air and gas is thoroughly effected before entering the cylinder by means of an annular mixing chamber located under the main inlet bonnet; the design and operation of this device is such that, at the instant of closing of the main inlet valve, there is practically no explosive mixture left outside the cylinder. The gas valve is of the double-beat poppet type controlled by a variable lift rolling lever operated by a single-link connection to the main inlet gear, the lift of the valve, and consequently the amount of gas admitted and the time of admission, being regulated by the governor. The exhaust gear is of the single-beat poppet valve type, eccentric operated, and is in this respect a duplicate of the main inlet gear. A distinctive feature of the Allis-Chalmers gas engine is the location of this exhaust bonnet with its valve at the bottom of the cylinder, where all the dirt is removed by the action of the exhaust gases and the provision of a substantial jack to lower the entire exhaust mechanism out of place to allow inspection and regrinding of the valve, and which also serves to swing the valve chamber, with the valve and its operating mechanism complete, out to one side where it can be reached by the crane hoist. The removal of one pin, either in the inlet or exhaust mechanism, is all that is necessary to allow the removal of either the inlet or exhaust bonnets, with their valves and entire operating mechanism, without disturbing any adjustment whatever.

The igniters are electrically controlled and so arranged that the time of ignition may be regulated by a single hand-wheel. Direct current at 60 volts is used in the ignition system. Duplicate igniters are provided at each end of the cylinder to insure prompt firing of low heat-value gases, and also to avoid the danger of shut-down due to short circuit. The entire ignition system, from the motor-generator set which furnishes the current to the electrically operated igniters, is very solidly built.

The air starting device consists of a small poppet inlet air valve at each end of each cylinder, with a main distributing valve operated by the layshaft. Air is admitted to each cylinder in turn at what would be the explosion stroke. As the high compression carried prevents the engine from stopping on the dead center, this arrangement insures the prompt starting of even a tandem engine without the use of a barring gear. The Port Washington engines being twin-tandem will, of course, start from any position.

The engines are exceptionally heavy and rigid, the weight being concentrated in the frame cylinders and tie-pieces in the direct line of the stresses to which an engine of this type is subjected. The engine frame is designed for a side crank in place of the double-throw crank which is the standard practice abroad. The stresses transmitted to the frame in a side-crank gas engine are very great, but, even in the largest sized gas engines, they are no greater than the Allis-Chalmers Company

has, for many years, successfully provided for in its steam engine practice. This is contrary to popular belief, but the stresses cared for in the engines operating the New York subway, for example, are as great as any that the gas engine is ordinarily called upon to sustain. The distinctive features of the engine are the extreme simplicity of design and the solidity of the construction and quiet operation.

The load at the present time is extremely variable, swinging from less than one-half to 50 per cent overload, with momentary peaks greatly in excess of this. It is only by a study of the switchboard instruments, however, that this is apparent, as the engine handles the maximum overloads as quietly and with the same freedom from vibration that characterizes its operation under normal conditions. To the observer there is no outward indication of the magnitude of the forces at work. The engine turns its centers as quietly as a slow-running Corliss engine, and is as indifferent to the rapid changes in load, impressing one with the tremendous reserve power in each unit.

All wearing surfaces, including the main bearings, slides, crank and cross-head pins, are arranged for a continuous oiling system, and the cylinders are lubricated by carefully timed admission of the cylinder oil, Richardson's sight-feed oil pumps being used.

The water cooling system includes ample provision for cooling the cylinder walls, cylinder heads, pistons, piston rods, exhaust valves and exhaust bonnets. Water is circulated by means of two Morris and two Deming pumps, each driven by an Allis-Chalmers induction motor.

The gas for the engine is furnished by producers operating on the Loomis-Pettibone system. The present installation comprises two generating units, each consisting of a pair of gas producers connected to a common economizer, wet scrubber and exhaust. The gas is delivered into a 30,000-cu. ft. holder. The normal rating of the present plant is 4000 horse-power, and it can carry 5000 horse-power for five hours' duration. Hocking Valley bituminous slack coal, containing about 11,500 B. t. u. per pound, is the fuel ordinarily used.

The plant is operated on the down-draft principle, the air

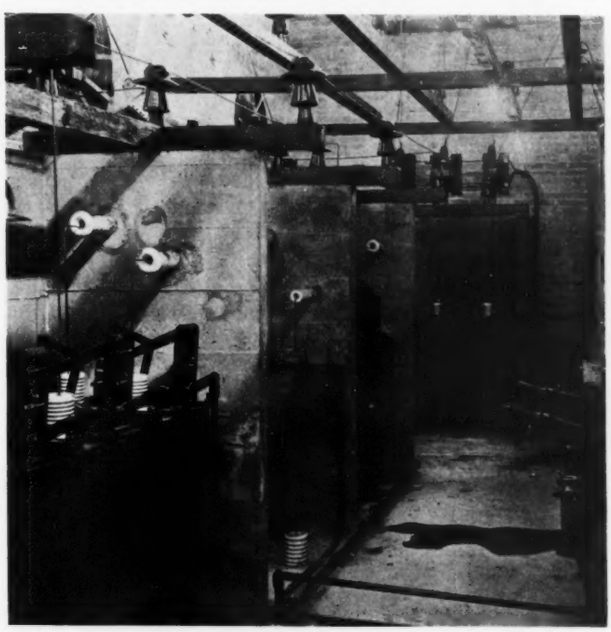


FIG. 2.—HIGH-TENSION SWITCHES IN CEDARBURG SUB-STATION.

being admitted through the charging door at the top of each producer, and the necessary suction being caused by an exhauster located beyond the wet scrubber. By this method the volatile matter and distillates are drawn through the deep bed of incandescent fuel and gasified, thus avoiding any tar extracting machinery, and enabling the system to produce gas obtaining 80 per cent of the heat units possessed by the fuel used. Reverse runs of steam, generated by the gas passing through the economizer, or waste heat boiler, are occasionally made for the purpose of breaking up the fuel bed. The water gas made by this process mixes with the producer gas in the holder and slightly enriches it. The average calorific value of the gas as delivered from the holder is 125 B. t. u. per cu. ft.

The revolving field cores of the generator are of special construction. The field poles, which are of solid cast-steel, are bolted to a heavy cast-iron spider; they can, therefore, be

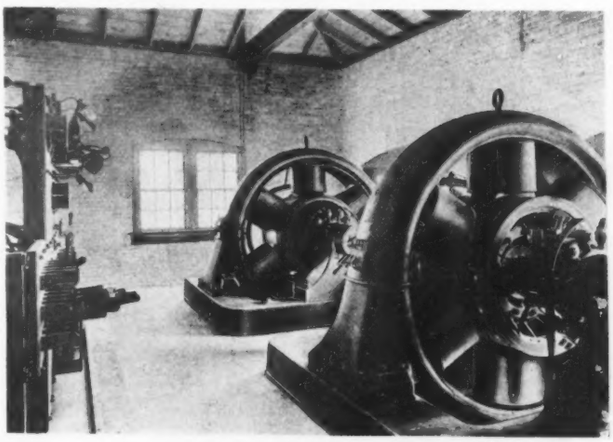


FIG. 3.—ROTARY CONVERTERS IN CEDARBURG SUB-STATION.

readily removed in case it is necessary to get at a field coil. The field windings are held in place partly by the projecting pole tips and partly by brass rings running completely around the rotor on each side and fastened to the tip of the poles by long brass screws. This construction, combined with the solid poles, gives a large damping effect, prevents hunting and aids in securing parallel operation.

Direct current for excitation is furnished by two 50-kw, 120-volt generators driven by vertical gas engines, the complete units being of Allis-Chalmers Company's build.

The current from the main generators is delivered to a six-panel switchboard, from which it is led to the step-up transformers and also to a rotary converter switchboard. There are seven Allis-Chalmers 500-kw transformers arranged in two banks of three each, with one held as a reserve. These transformers raise the e. m. f. from 405 volts to a maximum of 22,000 volts, with intermediate tap to allow the e. m. f. to be varied, if desired. The current from each bank of transformers passes to the high-tension bus through three 40-ampere oil switches in each circuit; in addition to plug switches at each transformer to allow for speedily cutting out any transformer in case of break-down. The station apparatus is protected from lightning by means of an equipment of low-equivalent lightning arresters and oil-immersed choke coils connected to the high-tension bus.

For supplying energy to nearby portions of the line two 300-kw rotary converters are provided in the main station. These, like all other rotary converters on the system, are of standard Allis-Chalmers design. They have six poles and run at 500 r. p. m., taking three-phase alternating current at 405 volts and delivering direct current at 650 volts.

There are eight sub-stations located along the right of way, two of which have two 400-kw, 650-volt rotary converters. Each of the remaining six sub-stations has two 300-kw rotary converters.

The present rolling stock consists of eight heavy interurban cars of the type known as the Semi-Empire Pullman, built by the Niles Car Manufacturing Company, of Niles, Ohio. Each car weighs, including trucks and motors, 70,000 lbs., and there are two 75-hp motors on each truck. The schedule speed is 25 miles per hour, including stops, with a possible maximum speed of 54 miles per hour. The cars are equipped with straight air-brake equipments manufactured by the Allis-Chalmers Company.

Polyphase Induction Motors.

The Triumph Electric Company, Cincinnati, Ohio, has placed upon the market a line of polyphase induction motors which embody the best features found in motors of European design. As will be noted from Fig. 1, ample openings are provided for the free circulation of air around the stator core and stator windings; the good ventilation thus obtained allows the active

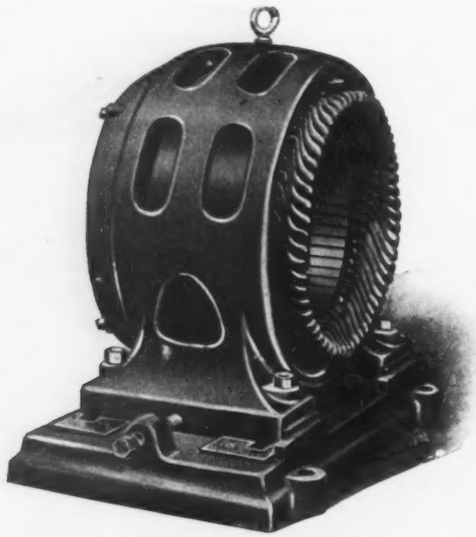


FIG. 1.—STATOR WITH END-BELL REMOVED.

material to be fully utilized and an inexpensive motor is the result. By the use of partially closed clots and a shallow air gap the power-factor has been kept high—varying from 92 in a 2-hp motor to 94 in a 20-hp motor. The bearings are liberally proportioned and the construction throughout is extremely rigid.

The standard motors are provided with squirrel-cage secon-

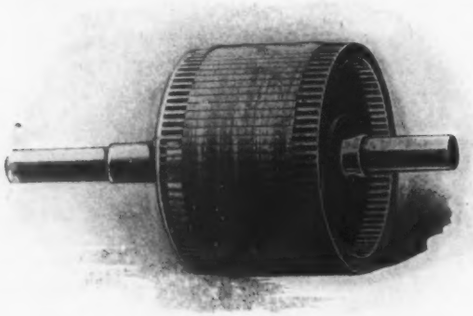


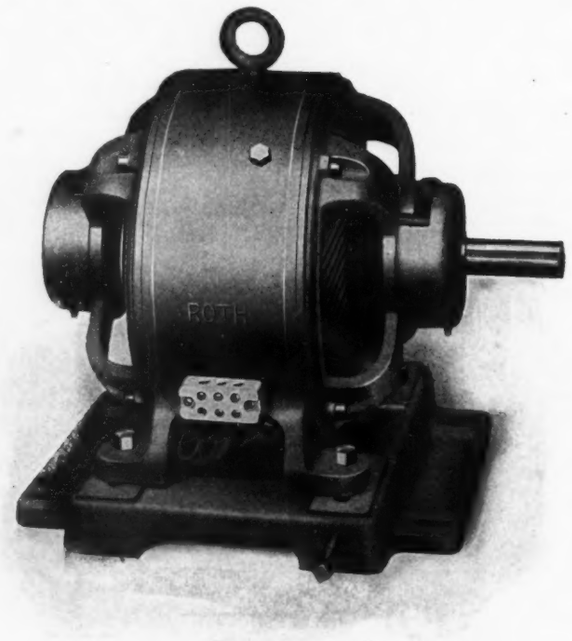
FIG. 2.—ROTOR COMPLETELY WOUND.

dary windings on the rotor, and they possess the extreme of simplicity. With this type of secondary, the drop in speed from no load to full load will not be more than 6 per cent in the smallest size, and it will be less in the larger sizes. For variable-speed work the motors are equipped with coil-wound rotors with slip-rings for the insertion of resistance in the secondary circuit. These motors operate at an efficiency which reaches .83 in a 2-hp rating and .865 in a 20-hp rating. In no case does the temperature-rise at full load exceed 40 deg. C.

Medium Size Direct-Current Motor.

The accompanying cut illustrates the new type "S" design recently put on the market by Roth Bros. & Company, of Chicago. This design is the result of a broad experience of the firm dating back to the early days of the electric motor. There is not a single point in the entire design which is so unusual that its value can be questioned. The design of each part has been made according to the accepted standards of construction that have proven themselves by long continued use. At the same time, by selecting properly the most suitable types of construction and combining them a more harmonious complete design is realized.

The frames are of cast steel finished all the way around inside. The poles are of laminated iron. The commutator

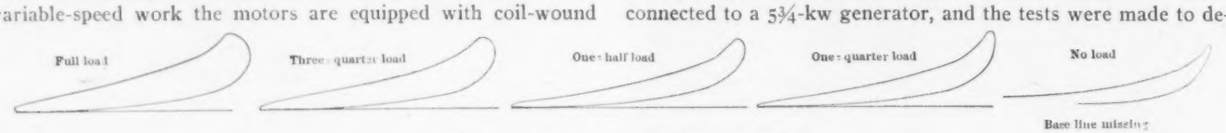


DIRECT-CURRENT MOTOR

is of large diameter with a large number of segments. The brush holders are supported from the rocker ring moving in a finished way on the frame. There are no band wires on the armature core. All windings are impregnated with water-proof and oil-proof gum. Effective safeguards are employed for preventing the oil from the bearings reaching the windings or the commutator. A 35-deg. C. rise is noted for continuous service.

Tests of Alcohol-Engine Generator Set.

Denatured alcohol as fuel for internal-combustion engines has so much to commend it that the following account of a test made on an alcohol-engine generator set marketed by Mr. August Mietz, of New York City, will doubtless be interesting. The engine used in the test was an 8-hp Mietz & Weiss three-port, two-cylinder, two-stroke cycle machine, which was direct-connected to a 5¾-kw generator, and the tests were made to determine the output and fuel consumption as well as to obtain curves showing variations of speed and load, port timing and comparative indicator diagrams. A standard oil engine was used, the only difference being in the compression and in the fuel, which was composed of the following ingredients: 100 parts by volume of grain alcohol, 10 parts of wood alcohol and one-half of a part of approved benzine. The denatured alcohol had a specific density of .83.



INDICATOR DIAGRAMS OF ALCOHOL ENGINE.

The pressure diagrams were taken by means of the Hospitalier-Carpentier manograph. These show conditions at full

load, three-quarter load, one-half load, one-quarter load and no load. The mean effective pressure at full load was 38.24 lbs., which represents 9.88 indicated horse-power. At the time the card was taken the engine was developing 7.6 brake horse-power, the difference, 2.28 horse-power, being expended in running the engine and generator.

It was noticed that when the valve was opened to take the indicator cards, the clearance in the instrument and connections resulted in a drop of about 15 r. p. m. and the ammeter showed a drop of two to three amperes. The compression used was 100 lbs. and the piston displacement was 206.75 cu. ins. The fuel used at the various loads was as follows:

	Pints Per Brake Horse-Power
Full load	1.87
Three-quarter load	2.04
One-half load	2.86
One-quarter load	3.95

The maximum speed variation was within 3 per cent from no-load to full-load, the speed varying from 519 r. p. m. to 505 r. p. m. A test run made with a constant load of 40 amperes showed a voltage variation of less than 1 per cent.

Automatic Controllers for Direct-Current Elevator Motors.

The controllers illustrated herewith possess the unique feature of causing the actual motion of the motor itself to vary the conditions of the control circuits. That is to say, the rheostat

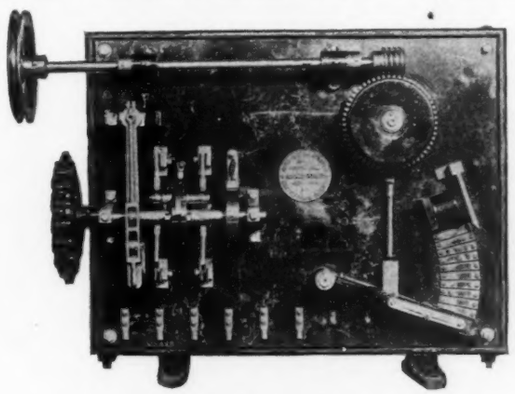


FIG. 1.—DIRECT-CURRENT ELEVATOR CONTROLLER.

arm moves at a speed depending solely upon the speed of the motor and in a direction variable at the will of the operator.

Fig. 1 shows a motor-driven controller for manually operated direct-current elevators. This controller provides absolute protection against overloading of the motor, and it parallels the

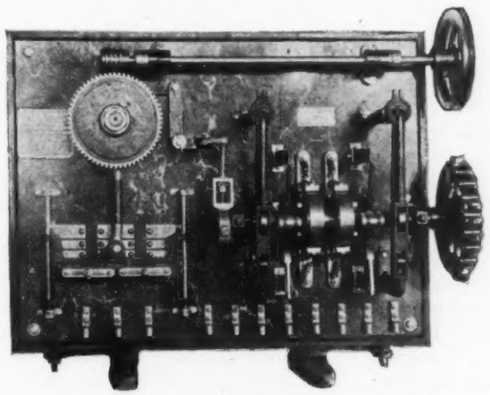


FIG. 2.—ALTERNATING-CURRENT ELEVATOR CONTROLLER.

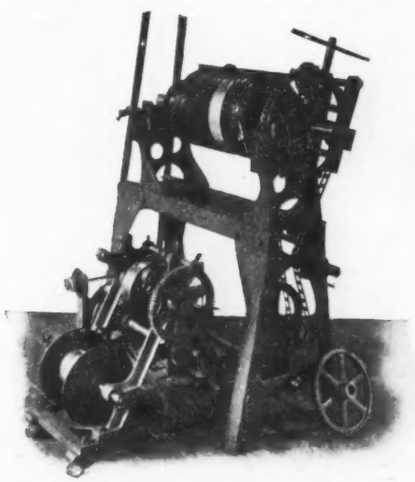
action of a controller on a hydraulic elevator in starting. There are no points on the entire controller where an arc can occur, except at the magnetic blow-out where carbon and copper butt contacts are used; these contacts being cheaply renewable, the cost of repairs is kept at a minimum. The reversing switch interrupts both the positive and the negative sides of the lines when opened.

Fig. 2 illustrates a motor-driven non-magnetic controller for polyphase induction motors with exterior secondary resistance. This controller is intended for use where the control of the car is mechanical. The device is set on the motor, the switch being connected to the shipper shaft by a standard sprocket chain to provide a throw of about 120 deg. either way from center. When the switch is thrown in either direction the eccentric on the extreme end of the switch shaft applies a mechanical clutch to the revolving worm wheel, so as to pull up the resistance arm as the motor accelerates, thus mechanically cutting out the resistance in series with the collector rings at a speed proportional to the load on the motor. When the switch is centered, the clutching effect being disengaged through the movement of the eccentric, the resistance arm will fall by gravity, thus reinstating the resistance.

These controllers are designed and built by the Automatic Switch Company, 131 Liberty Street, New York.

Combined Tension and Banding Machine.

The Device Improvement Company, of Hanover, Pa., has designed a machine along new lines for the exclusive purpose of banding armatures and winding field and armature coils. In connection with this is a machine for giving an accurate and uniform tension to the band wire. The latter machine consists of two side frames mounted on angle-steel sills and casters. The lower shaft runs in babbitted bearings, and one end carries the brake pulley. On the other end is a pinion which engages with the gear on the upper shaft, this ratio being 3 to 1. On the gear is mounted a large drum for the insulated wire and on the shaft the tapered, flanged band-wire drum. The taper is so designed that the tendency of the wire to crawl up is neutralized. Six or seven turns of the band wire



COMBINED TENSION AND BANDING MACHINE.

on this drum will hold any tension desired. At the front end of the frame is mounted the cast-iron band wire spool, with the small retarding brake, as shown. The band wire passes off the spool to the grooved lead on the pulley, thence to the drum, around the drum to the grooved lead-off pulley and thence to the armature to be banded. The tension index with which the machine is provided has ten divisions, each of which corresponds to a different tension.

The banding machine consists of two cast-iron legs bolted to a steel bed, the legs containing the babbitted bearings for the shafts and belt shifter. The left-hand head is bolted to the bed; but the right-hand head is adjustable to accommodate armatures of different lengths. The armature shaft revolves in each head on two brass rollers. The outer bearings are adjustable. Each head carries an inwardly projecting arm, to which the slotted strips carrying the steel feed rod are fast-

ened. The rod can be adjusted to suit the operator. The feed rod is of steel, threaded its entire length to receive the feed wheel, which carries on its hub the independently revolving grooved wheel for guiding the band wire. The armature is driven by a clutch sprocket wheel and a detachable link chain. The clutch jaws are self-centering on the shaft in one direction and the shaft need only be approximately centered by the eye in the other direction, as any discrepancy due to the sprocket not being centered is taken up by the slack in the chain and in the idler. Power is transmitted direct from the line shaft by a belt, but the machine can easily be adapted for individual motor drive. The speed of the armature may be increased or reduced by changing the speed of the driving shaft, and this requires but the time necessary to remove one gear and substitute another. The stopping and starting of the machine is controlled by a foot lever, which when depressed applies the brake, locks the driving shaft and shifts the belt to the loose pulley. To start the machine, the lever is disengaged from the dog screwed to the floor, and the springs on the outside of the belt-shifting rod automatically pull the belt to the tight pulley and release the brake. The method of control is quick, positive and sensitive, it being possible to move the armature ½ in. or less. The hands of the operator are also free to perform banding, soldering and other operations. The banding and winding machine is separate from the wire tension machine; but the combination is very useful for repair work or for doing the original banding work, and in the case of the tension machine for winding coils.

Portable Lamps and Fixtures for Christmas Trade.

The Central Electric Company of Fifth Avenue, Chicago, has prepared and sent out a very attractive and interesting folder intended to reach and help Christmas trade.

Portable lamps and fixtures have been given very little attention by electrical supply houses, at least in the West, whereas they are devoting considerable effort to pushing heating apparatus and central-station supplies. The Central Electric Company has devoted considerable attention to the electric fixture line and has a very handsome show room for this class of

PORTABLE LAMP.

material, fitted up at a considerable expense, where central-station managers feel that they can send their customers, when visiting the city, to select something in the fixture line. It is really surprising to see the number of calls from out of town visitors who are sent in by central-station men to make selections. There seems to have been a very large demand for electric lamps during the past two years and the lighting effects which are secured by means of art glass shades are each year becoming more elaborate. The folder illustrates a number of artistic portables and fixtures, one of which is shown herewith.

Universal Insulator Supports.

The accompanying illustrations show applications of the universal insulator supports marketed by the Electric Controller & Supply Company, of Cleveland, Ohio. It has long been recognized that the most difficult part of a wiring job in steel frame mill and factory work has been in obtaining a secure support

FIG. 1.—INSULATOR SUPPORTS.

for the insulators. Expensive and special work is usually the result and no two jobs are done in the same way. The universal support shown in the illustrations can be used in any position on the flanges of any known rolled-steel structural shape: beams, angles, channels, Z-bars, round, square and flat bars, gas and water pipes, edges of tanks, plates, etc. By this means

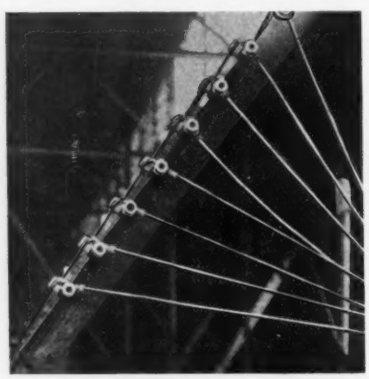


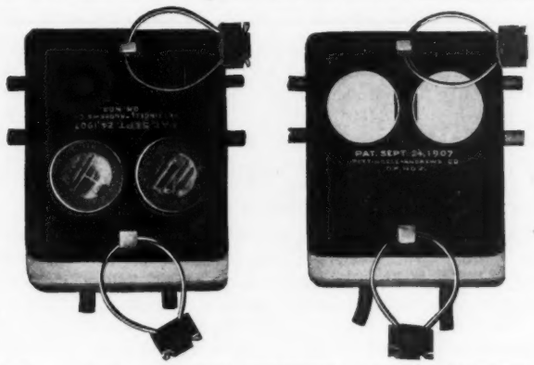
FIG. 2.—INSULATOR SUPPORTS.

it is possible to avoid all preliminary work as well as the expense and vexation connected with it. No woodwork is required, so that the element of danger from fire or loosening of supports due to shrinkage is eliminated. No holes need be drilled, and the use of cup-pointed hardened set screws and a clamp form of great strength prevent the supports working loose, even under severe vibration. The set screws cut into the metal and are securely anchored. The clamps are made of malleable iron and are suitable for light or heavy work.

Fuse Block Cover.

The accompanying illustrations show applications of the "O. K." fuse-block cover made by the Pettingell-Andrews Company, of Boston, Mass. The device is primarily intended to prevent theft of energy by sealing all live parts of the circuit, but allowing access to the fuses except in cases of discontinued service, when by a reversal of the steel face-plate no service connection is possible without breaking the seals. In apartment-house wiring and in similar classes of service, where several customers have meters, it is desirable that all conductors to the meter be so covered that it is impossible to leave the wiring in such condition that any unauthorized work would not be apparent upon inspection. It is also desirable in cases of discontinued service to be able to seal the branch block so that it is impossible to insert fuses or make any illegal connection without breaking

a seal. These results are said to be accomplished by the use of the fuse-block cover shown. This consists of a porcelain canopy and steel face-plate that completely enclose the fuse block. The porcelain canopy is held by the screws which fasten the fuse block in place and the screws are covered by

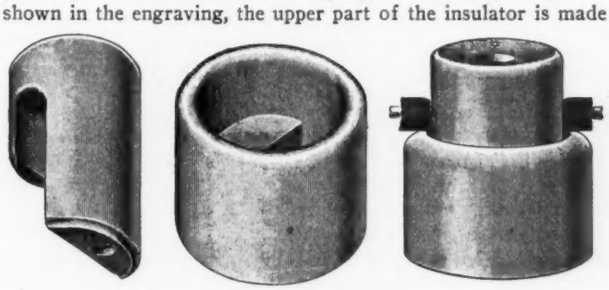


FIGS. 1 AND 2.—SERVICE CONNECTED AND DISCONNECTED.

the face-plate which is itself held in place by the seals. The latter are attached to metal posts that form part of the porcelain canopy. The canopies fit all branch blocks for Edison plug fuses and a screw-driver is the only tool needed to install the device on existing services equipped with Edison plug cut-outs.

Porcelain Insulator.

The latest type of confining insulator designed to get rid of the tie wire is shown herewith. The insulator is made in two parts by the Star Porcelain Company, of Trenton, N. J. As shown in the engraving, the upper part of the insulator is made



PORCELAIN INSULATOR.

to straddle the wire and the projection of the lower portion, on which the wire rests, is so shaped that when the upper part is fastened in place, the wire is curved slightly and thus resists any slipping or pulling action. The wire is thereby not only safely insulated, but securely fastened. A screw passing through one side of the top part, and also through the lower part, serves to hold the insulator in place. Between the screw and the wire is a wall of porcelain, so that contact between them is not possible. The insulator is said to meet all the requirements of the fire underwriters.

Fireproof Insulation.

During the past few years materials possessing both insulating and fire-resisting qualities have been used for arc lamp coils and also for the insulation of motor field coils, especially in railway motors, where, because of location and operating conditions, insulating material not possessing fire-resisting qualities is short lived. Asbestos has been used and is now being used in one form or another as the insulating substance because of its well-known fire-resisting qualities. The commercial asbestos, however, contains various other substances, such as salts of iron, magnesia, etc., which rather detract from its efficacy as an insulating material. The Green Insulation Company, of Cleveland, Ohio, has brought out a fire-resisting material which also possesses marked insulating properties. By combining various other substances with the silica of asbestos so as to remove the impurities, the company has produced a fibrous quartz. This mineral is claimed to be non-carbonizing, non-disintegrating, indestructible, and from its nature is said to possess greater utility than like substances and to conduct heat readily.

The quartz is spun into cord, incorporated in sheets, rubber compound, porcelain, etc., for various electrical uses, increasing many times the insulating qualities of paper, fibre, etc., in which asbestos has been hitherto incorporated. Insulation tests of fibrous quartz paper, that is, paper made with an inner layer of manila paper for imparting strength, have given the following results:

Condition	Thickness, Mils	Volts Per Mil
Normal	10.8	175
Baked	10.8	182
Burned	10.8	183
Wet	10.8	99

In these tests the fibrous quartz paper was baked at a temperature of 200 deg. F. for four hours; was burned in the flame of a bunsen burner, and was soaked in water, the surface water being removed with blotting paper.

The company is placing on the market a fibrous quartz paper and tape which can be used anywhere on electrical appliances. Wire as small as No. 18 gauge has been made with fibrous quartz as the insulating material.

Wire Coiling Reel for Counter Use.

The accompanying illustrations, which show a recently developed oiling reel in use and after forming a coil, are self-

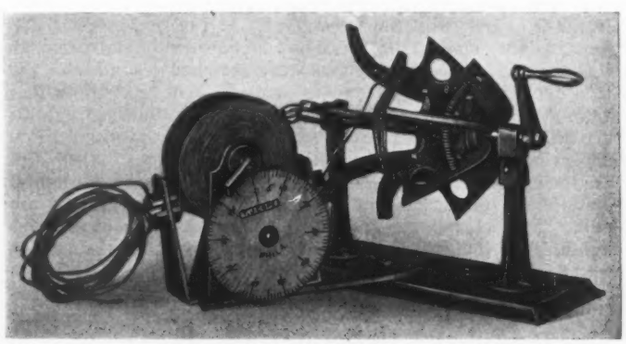


FIG. 1.—REEL OPEN AND IN USE.

explanatory. The reel is simple in detail and strong in construction, yet it occupies little counter room. It has been designed for coiling wire measuring not more than 5/16 in. in

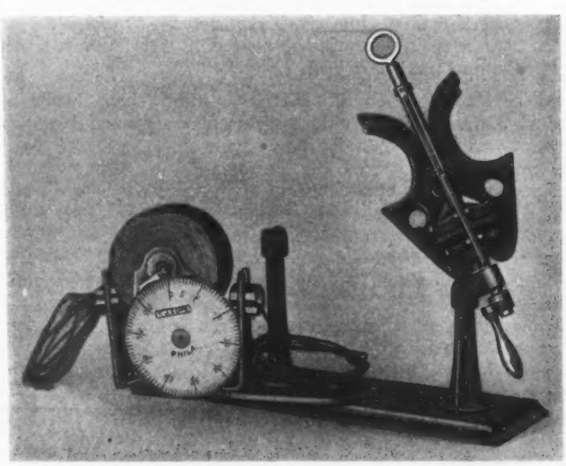


FIG. 2.—REEL COLLAPSED AFTER FORMING A COIL.

diameter. When desired, it can be equipped with a measuring attachment for showing the length of wire in each coil.

The above-described reel has been placed on the market by T. J. Cope, 3244 North Fifteenth Street, Philadelphia, Pa.

Industrial and Commercial News.

Commercial Intelligence.

THE WEEK IN TRADE.—The improvement in financial matters gave a more cheerful tone to the whole situation. Trade, however, is still quiet throughout the country and new buying is small, while the industrial operations are still being restricted. With the more easy money situation has come a more liberal marketing of the country's products. Commodity prices were irregular, the cereals and cotton advancing, while provisions, meats and other food products declined. Railroad traffic was appreciably smaller than in many weeks past, and the car shortage trouble has disappeared. Large numbers of men employed in railway construction work have been laid off and building is apparently much less active. These two features, however, are not uncommon as the winter season approaches. In distributive trade conservatism was manifested in buying for immediate necessities, and a disposition shown to postpone future buying till later. Many manufacturers have aided in restoring confidence by giving notice that cancellations will not be accepted, though delivery may be delayed to suit conditions. On the other hand, there is no disposition to accumulate stocks, and factories are suspending or curtailing where necessary. Collections are still poor, with numerous extensions being asked for and in many cases granted. While the banking situation is improving, loans are not being made with any degree of freedom and rates are still prohibitive. There is a better feeling in the iron and steel trade as regards the future, but new business is light and curtailment of production continuous although it is reported that a few plants have resumed operations. Pig iron quotations are now from 14 to 29 per cent lower than they were at this time last year. Finished lines are dull, and outputs are being adjusted in keeping with the volume of specifications appearing. Wage reductions that average about 10 per cent are being made. The volume of new business in structural materials is small, and transactions in standard steel rails are dull. The demand for copper from domestic consumers was lighter than it has been at any time this year, but the market was firmer in sympathy with the advance in standard warrants at London. Exports for November are expected to score another new record. Prices were raised, but it is thought the advance was due to manipulation rather than to commercial conditions. The closing quotations were 13¾c. for Lake, 13½c. for electrolytic, and 13¼c. for casting. The liabilities of commercial failures reported for November are $12,208,092 against $6,809,601 for the same period last year. Of these failures $6,835,000 were of manufacturing concerns, $4,344,000 in trading, and $1,028,000 in other commercial lines. The failures during the week ending Nov. 28 as reported by *Bradstreet's* numbered 256 as against 265 in the preceding week and 174 in the corresponding week last year.

AMERICAN EXPORT TRADE.—The share which the United States supplies of the imports of the principal countries of the world is shown in a statement just published by the Bureau of Statistics of the Department of Commerce and Labor. It puts the total imports of merchandise into all countries of the world in the latest available year at 14,131 million dollars, speaking in round terms, and those of all countries other than the United States at 12,697 millions. Of this 12,697 million dollars' worth of merchandise imported by countries other than the United States, that from this country is set down at 1862 millions, or 14.7 per cent of the total imports of those countries as a whole. The largest importer of merchandise is the United Kingdom, and it also imports a much larger value of our merchandise than does any other country, its total imports being 2958 millions, and those from the United States 638 millions, forming 21.6 per cent of the total imports of that country. The second in importance in value of imports is Germany, whose total imports are set down at 1697 millions, and it also ranks second in the importations of merchandise from the United States, the total drawn from this country being 236 millions, forming 13.9 per cent of the total imports. The next in order of magnitude of imports is the United States, whose imports are given at 1434 millions. Then comes Netherlands with imports of 1031 millions, of which 97 millions is drawn from the United States, our merchandise forming only 9.4 per cent of the total imports. France is the remaining billion dollar country in the list so far as relates to imports, the total value of merchandise imported into France being 1009 million dollars, of which 100 millions, speaking in round terms, is drawn from the United States, and forming 9.9 per cent of the total imports.

PUBLIC SERVICE PRICES.—Mr. F. Rice, Jr., in an article in November *Moody's Magazine*, points to a probable increase in the charges for public service. He says: "Prices of various kinds of public service have remained stationary, or, in many instances have been decreased, during an era when all the other necessities of living have greatly advanced in cost. The citizen to-day can ride at least as far by trolley for 5 cents as he could ride ten years ago. Railroad fares are no higher; in some States they have been reduced, by action of hostile legislatures, below the point of yielding a fair profit. It costs more to send telegrams now than then. Telephone rates have frequently been reduced by the companies of the system which operates on a national scale, both at points where competition exists and where competition does not exist. Electric lighting has not, as a rule, become more expensive than it was. So that the average man with a fixed income, who complains because $1,000 or $2,000 seems to have hardly more than two-thirds its former purchasing value, has, at least, to be thankful that enhanced contributions to the coffers of public service corporations have not helped to contribute to his burden. Indications are not wanting that, in some instances, the limit of stability of service charges, during this period of high prices and prosperity, has about been reached. It is suspected that not a few American public service companies are face to face with the alternative either of raising their rates moderately, to compensate for the greatly increased cost of operating, or of incurring loss of dividend-paying power, or something worse. If anything like the present tension continues we shall not unlikely, within the next few months, see many a corporation compelled to revise its scale of rates."

ELECTRIC MOTORS IN ITALY.—U. S. Consul James E. Dunning, of Milan, reports that his office has received the official publication upon electrical power in Italy, in which the factory inspectors show the continued use of that form of power in the country. The consul says: "The consulate at Milan has frequently had occasion to comment on the rapid development of electrical energy as a motive power in Italy, and particularly in the northern provinces, where the manufacturing interests center. The report for 1906 shows that at Milan alone about one-quarter of the total new work was put into operation, while the development through the peninsula was general; 125 new electrical plants were built, and 114 extensions of existing plants were effected."

APPARATUS FOR SAN FRANCISCO.—The City Electric Company, of San Francisco, has closed a contract with the Westinghouse Machine and Westinghouse Electric & Manufacturing Company, of Pittsburg, for a 10,000-hp turbo-generator. This will be the largest machine of its kind in the world, and will cost $300,000. Two smaller generators of the same type are now in use by the City Electric Company and the large machine that has just been ordered will greatly increase the capacity of their power-house at Beach and Mason streets. The United Railroads expects to obtain from this company a large supply of power for running its cars, and the plant is being improved accordingly.

ELECTRIC CRANES.—The new power station of the Columbia Improvement Company, Seattle, Wash., will be served by a 50-ton, 3-motor electric Northern traveling crane, furnished by the Northern Engineering Works, Detroit, Mich. The United Engineering & Foundry Company, Pittsburg Plant, has recently installed a 10-ton, 60-ft. span electric Northern traveling crane.

PLANT FOR MARE ISLAND.—The navy department bureau of yards and docks asks $786,800 for improvements at

Mare Island next year. The principal item is $385,000 for a central power plant. The yard is now purchasing its power from a company.

HANDLING TROLLEY TRAFFIC.—Sir Clifton Robinson, of the surface and underground railway systems of London, prior to his departure for Japan on a trip around the world has devoted most of the time to observing the traffic conditions in the congested centers. "The order and precision," he said, "with which this dense volume of traffic adjusts itself to the local conditions is to me nothing short of marvelous. There seems to be an utter absence of even an attempt to control or shepherd the congested throng. We are obliged to have police to control our crowds in London. Usage and custom, as it were, turn them here into the channels which they follow automatically. The measure of the accommodations is limited only by the packing capacity. Tramways have grown to be an institution in New York, and are recognized as part and parcel of the daily life of its millions of busy workers. Their success was assured from the first by the adoption of a flat rate with one class and an utter absence of any difficulty in the way of caste prejudice. The people of New York are seeking to do away with straphanging while the masses in London, who are now beginning to realize the value of time, are trying to introduce it. The police there rigidily enforce the old stage coach laws, which were framed for animal not for electric traction. Passengers who are found standing in a car are fined $2.50, as well as the conductor, and besides, they have to waste half a day in court. This comes very hard on gallant men who get up to give their seats to ladies. This is a direct result of the closer connections between New York and London in the last few years. The Londoner has seen that he has an efficient street car and underground service, and it has induced him to travel, but it takes a long time to educate him. The solution of the traffic problem will be found when the public and the traffic men strike a happy mean. That is to say, that the public must recognize the authority and use their own common sense to alleviate the congestion when possible. For example: I have noticed that at terminal points like East Twenty-Third Street the people all crowd into one car when there are four or five empty cars in line, because they would sooner suffer discomfort than wait for even a moment. The company takes advantage of that weakness and holds a car until it is packed to its capacity. Much can be done to improve conditions here by the company organizing a service on the broadest and most complete lines with equitable fares, up to date equipment and intelligent officials."

ELECTRIC DRIVE IN COTTON MILLS.—In commenting upon the present prosperous conditions of English cotton and woolen mills, in which about 8,000,000 new spindles and 77,000 new looms have been added this year, a London trade paper remarks upon the great advancement in favor which has been recently made by electric drive in competition with steam and shaft drive. It is no less apparent that American cotton and woolen mills are as much alive to the advantages of electric drive as the English manufacturers and have been so for some time. The steadiness of driving securable by means of the electric motor brings a consequently greater and more perfect output of each machine. The independence of machines gives greater freedom from break downs, and less cost in running on light loads. The electric system enables a constant check to be made upon the power consumption of each department. It also simplifies matters, since it makes easy the lighting of the mill. Although in some cases it may be found more economical to purchase power, with the greater number of machines it pays to generate it at the mill itself and to drive the machinery in groups, each from high-speed shafts coupled direct to motors. The steam turbine alternator of the improved horizontal type, built by Allis-Chalmers Company, Milwaukee, has, within the past year, been received with favor by Eastern and Southern mills for the operation of this class of machinery. The Allis-Chalmers Company has received contracts for nine units within the past few months, aggregating in capacity many thousands of horse-power. They comprise installations in the following mills: Jamestown Woolen Mills, Jamestown, N. J.; Cherry Cotton Mills, Florence, Ala.; Lawton Spinning Company, Woonsocket, R. I.; Pacific Mills, Lawrence, Mass.; American Thread Company, Fall River, Mass.; Tremont and Suffolk Mills, Lawrence, Mass.

AMERICAN CONDITIONS.—M. Dupont, member of a well known Franco-American firm of bankers, Dupont & Furland, in a recent discussion of American conditions says: "With this American spirit of daring it is not surprising that much of the business of the country—and of the very best—rests to a great extent on credit. They forget too easily in America the relation which should exist between the working capital of a concern and the amount of business it tries to do. The American never anticipates hard times. For him American prosperity must go on without a halt. That is how it happens now and again that a company, at the height of its prosperity, must go into the hands of a receiver. Banks cannot go on renewing paper forever, be the paper of the best. I think that it can be said, therefore, without contradiction that the primary cause of the present crisis is the abuse of credit. Newspapers have also had much to say about speculation and overcapitalization. Overcapitalization exists in America, I must admit, just as it does in every other country of the world. But this view always supplies its own remedy. The company's earning power either makes good this excess of capitalization or the price of the stock shrinks until its real value is reached. In America, as more or less everywhere else, those who risk their money in founding a company are rewarded with shares of common stock —a tangible form of the company's hopes. This stock very often later on goes far above par. Is its real value decreased by the fact that the stock cost nothing in the first place? The stock exchanges of the world answer the question. Americans, temperamentally, are more inclined to speculate perhaps than some of their neighbors, but I do not think that speculation, any more than overcapitalization, can be considered as real factors in the crisis. They are contributory causes in a way, for they increase the need of ready money, but they are not the real causes, despite sensational charges to the contrary."

WHAT THE FARMS DO.—The annual report of the Department of Agriculture, just issued by Secretary James Wilson, says: "The value of the total farm productions in 1907 exceeded that of 1906, which was far above that of any preceding year. The total value for 1907 is $7,412,000,000, an amount 10 per cent greater than the total for 1906, 17 per cent greater than that of 1905, 20 per cent above that of 1904, and 55 per cent in excess of that for 1903, and 57 per cent greater than the total value for 1899. If we let 100 represent the total value for 1899, the value for 1903 would be represented by 125; that for 1904 by 131, for 1905 by 134, for 1906 by 143, and the total value for 1907 by 157. The animals sold from farms and those slaughtered on them in 1907 were worth about $1,270,000,000, or nearly twice as much as the cotton crop. During the fiscal year 1907 the exports of farm products exceeded the imports by $444,000,000, a balance that has been exceeded only four times—in 1898, 1899, 1901, and 1902. Our foreign credit is sustained mainly by our farmers. For eighteen years, beginning with 1890, the farmers have not failed to secure a favorable balance, the lowest being that of 1895—$193,000,000, and the grand aggregate of the balances of trade in farm products for the eighteen years is $6,500,000,000."

LARGE EUROPEAN PLANT.—One of the American consuls in Europe mentions the proposed construction of a private electrical generating plant of 100,000 horse-power, and suggests to the Department of Commerce and Labor that American manufacturers might like to bid on it, if the work is actually given out.

CRANES FOR IRON WORKS.—The new foundry of the Clyde Iron Works, Duluth, will be operated by alternating current motors and will be equipped with two 10-ton and one 15-ton electric traveling cranes of about 40-ft. span. These cranes are to be of the Northern type, furnished by the Northern Engineering Works, of Detroit, Mich.

POSTOFFICE FACILITIES are largely the subject of the admirable report of Postmaster-General Meyer. He renews his recommendations of postal savings banks, limiting deposits to $500 per individual, and urges strongly a parcels post. Mr. Meyer points out that under the present system a person mailing in any United States postoffice two parcels weighing 4 lbs. each must pay 64 cents for the one addressed to New York and only 48 cents for the one sent to a foreign country, which will usually pass through New York. If the New York package weighs more than 4 lbs. it will be denied the mails, but the package going abroad may weigh up to 11 lbs., according to the country of its destination. The postmaster-general recommends a rate of 12 cents a pound on domestic parcels and a weight

limit of 11 lbs. He also proposes the establishment of a special parcel post system on rural delivery routes for packages originating on a rural route at the rate of 5 cents for the first pound and 2 cents for each additional pound up to 11 lbs. Mr. Meyer argues that this will be a great boon to farmers, facilitate consumption and increase the business of the country merchant. "The retail merchants in cities," he says, "have found that they increased their trade by delivering goods to their customers. The parcel post on rural routes will enable the local country merchant to deliver goods to his buyers at an average cost of about 2 cents a pound, or 25 cents for 11 lbs., while the wholesale merchant, in order to reach these consumers by mail, will be compelled to pay 12 cents a pound, or $1.32 for 11 lbs. Therefore, to gain the benefit of the special rates on rural routes, they would find it necessary to ship by freight to the point of the rural routes and be obliged to establish many thousands of agencies and depots for handling. It is of incalculable importance that the country merchant should exist and prosper."

SMALLER BUSINESS FAILURES.—A very good sign of business improvement is seen in the reports of commercial failures in the United States for November, which, as compiled by Dun's Review, show a decrease of about $10,000,000 in the liabilities as compared with those of October. The actual failures, as reported, were 1180 in number and involved $17,637,011 of defaulted indebtedness. Although these figures show a heavy increase as compared with the same month last year, in which the total was only 885 failures, with liabilities of $11,980,782, they are smaller than for any monthly period since the financial and business situation became acute, and, in the amount of defaulted indebtedness, are smaller than September's showing. The returns indicate that the only noticeable increase of liabilities over the figures for the same month last year ocurred in the manufacturing class, though numerous small firms were forced to suspend among traders. "The mortality was greater than normal, owing to the strained monetary situation and not because of poor business, and a comparatively few large failures in the manufacturing division supplied the only increase above an average month's liabilities." Comparison with last year's figures at this time is much less significant than the great improvement that is shown over the losses of the preceding month. The Review says: "During November there were 30 suspensions of banks and other financial institutions, the liabilities thus far reported aggregating $9,144,225, but returns are not yet available in many cases. Most of these suspensions are of comparatively small concerns, and several of the institutions have resumed." The figures in detail show that "manufacturing failures were 305 in number and $10,927,598 in amount, compared with 212 defaults in the same month last year, when the amount involved was only $3,291,192. Trading failures were 840 in number and $5,640,065 in amount, against 647 failures last year, with liabilities of $4,390,415. There were 35 other commercial failures, including brokerage, real estate, insurance and similar concerns, with a defaulted indebtedness of $1,069,348, against 26 similar failures last year, when the amount involved was $4,299,175."

AMERICAN SCHOOL OF CORRESPONDENCE has recently erected a fine building for itself in Chicago on Washington Park and Midway Plaisance, near the University of Chicago. It is built of paving brick in two shades, with Bedford stone trimming and green tile roof. It is four stories and basement, enclosing on two sides an open court 60 ft. square, walled in the rear and entered through an arched driveway. . The interior woodwork is green quartered oak. The administrative offices of the school are on the second floor; the remainder of the building is used for the accommodation of the large staff of instructors, editors and other employees in charge of the various details of the work of the school. An interior telephone system connects all departments. To facilitate the work of the business office and mailing room, several of the latest electrical appliances have been installed, including adding machines, folding machines and envelope sealers—all operated by electric motor. In the basement are the stock room, the shipping room and the steam heating plant. The system of heating is known as the "direct-indirect;" the larger radiators are located in juxtaposition to cold-air ducts that lead from the outside through the walls and that supply an abundance of fresh air at all times. Electricity is used throughout for lighting purposes. The corridors and large rooms are equipped with Nernst lamps. Lavatories with hot and cold water are located on each floor. On the second floor are the lecture room, and the rest room for employees. The lecture room is used as a meeting place for the clubs that have been formed at the works of the Crane Company, the McCormick Harvester Company and other large manufacturing plants in and near Chicago. At these plants students of the American School have organized, appointed leaders from their own number, and found mutual assistance in studying together. From time to time they meet in the lecture room of the school, where they are provided with instructors, apparatus and—since most of them come direct from the shop to the school—with a substantial lunch, all for the usual tuition. The school also provides its employees with free coffee and lunch at noon time.

FOREIGN TRADE FIGURES.—Although the foreign trade of the year in the gross is much larger than last year, the difference in our favor is less. The business disturbances of the past two months are shown in the October statement of imports and exports, in which there is a combined increase of $17,456,000, compared with October, 1906. Among imports the heaviest decline is shown in the classes of commodities known as materials for manufacture, both crude and partially manufactured. These two together make a loss of $6,373,000. The only other item showing a decrease is foodstuffs, where the small total of $281,434 is noted. On the side of exports for October the most notable decrease was that in crude materials for use in manufactures, amounting to $12,558,765. These shrinkages are partly balanced by gains in exports of other foodstuffs and provisions, of semi-manufactures and of finished manufactures amounting in all to $9,025,000. Nevertheless the losses of the month are greater than the gains. For the ten months ending with October the increase in imports ran above last year by $153,602,000, while the export movement, both domestic and foreign, gained $86,821,000. The gains of imports are 45 per cent greater than those of exports. Comparing volumes of business, however, the export trade is still considerably in advance. The aggregates for the ten months are as follows:

	1907.	1906.	
Exports	$1,512,009,000	$1,425,188,000	Inc. $86,821,000
Imports	1,219,997,000	1,066,395,000	Inc. 153,602,000
Differences	$292,012,000	$358,793,000	Dec. $66,781,000

GREAT COPPER EXPORT.—The extent of foreign purchases of copper metal here last month, which ran prices up suddenly from 12 to 15 cents a pound, is shown by the publication of the export returns for November. Altogether, 33,787 tons of copper were shipped last month, establishing a new record, and bringing the total of 1907 to date to a figure only 1448 tons below last year's exports. The increase over October was 5001 tons, over November last year 15,336 tons. The following table shows the monthly comparison of our copper exports for the past four years:

	1906-7. Tons.	1905-6. Tons.	1904-5. Tons.	1903-4. Tons.
November	33,787	18,451	13,195	22,294
October	28,786	17,528	17,784	26,585
September	17,157	14,119	19,755	20,569
August	13,208	20,433	22,692	24,906
July	14,646	18,309	18,478	19,490
June	16,193	18,634	22,096	16,279
May	8,373	19,260	23,758	14,772
April	17,263	16,330	24,121	13,383
March	13,006	16,433	21,073	22,852
February	9,072	15,801	17,508	17,073
January	17,089	15,307	21,245	29,085
December	13,992	18,158	19,847	15,857

The previous record was in January, 1904. Since Jan. 1, last, reports have been 189,167 tons, comparing with 190,615 tons in the same period last year.

AMERICAN INSTRUMENT COMPANY.—This company has received important orders for switchboard instruments to be installed in plants of the Philadelphia Electric Company, S. L. Allen & Company, Carnegie Steel Company, American Steel & Wire Company, National Tube Company, and the U. S. Steel Corporation at Gary, Ind.

Financial Intelligence.

THE WEEK IN WALL STREET.—Both sentiment and prices on the stock market tended to improve on the decreased money market pressure and the indications of a return to normal conditions in that respect. Much irregularity, however, prevailed and certain portions of the list, notably the Gould group, exhibited weakness and recorded new low-record prices in the face of a stronger tone elsewhere. Western Union also showed much unsteadiness and fell to 54⅛. There was likewise pressure in connection with Pennsylvania and New York Central. On the other hand, a variety of favorite trading stocks developed strength—Reading, Union Pacific, the Hill group and

Amalgamated Copper being prominent in the activity. United States Steel issues were irregular. Most of the electric and traction stocks made substantial gains during the week, the net advances being as follows: General Electric, 6 points; Westinghouse, 5¼ points; Mackay preferred, 3 points; American Telephone & Telegraph, 4¾ points, and Interborough Metropolitan preferred, 3½ points. Western Union declined 2⅝ points. On the Curb liquidation came to an end early in the week, and thereafter there was gradual improvement, the week ending with some noteworthy gains. Following are the closing quotations of Dec. 3:

NEW YORK.

	Nov. 25	Dec. 3		Nov. 25	Dec. 3
Allis-Chalmers Co.....	4⅞	5⅞	General Electric 107		115¼
Allis-Chalmers Co. pfd.	12	15½	Hudson River Tel.....	—	—
Am. Dist. Tel.....	—	—	Interborough Met. com.	5⅝	7
American Locomotive...	35¼	36¾	Interborough Met. pfd..	15¾	18
Amer. Locomotive pfd..	85	86	Mackay Cos.	47½	50¾
American Tel. & Cable..	60	—	Mackay Cos. pfd.....	53⅜	60
American Tel. & Tel....	—	100½	Marconi Tel.	—	—
Brooklyn Rapid Transit.	31½	35⅞	Metropolitan St. Ry....—		—
Electric Boat	—	—	N. Y. & N. J. Tel.....	—	97½
Electric Boat pfd.....	—	—	Western Union Tel....	60	58½
Electric Vehicle	—	—	Westinghouse com.....	36	46
Electric Vehicle pfd....	—	—	Westinghouse pfd.....	—	61

BOSTON.

	Nov. 25	Dec. 3		Nov. 25	Dec. 3
American Tel. & Tel...	96⅜	101¾	Mass. Elec. Ry. pfd...	—	39
Cumberland Telephone..	—	—	Mexican Telephone....	1⅛	1¼
Edison Elec. Illum....195¾		200	New England Telep....	99	99½
General Electric	—	116	Western Tel. & Tel....	—	—
Mass. Elec. Ry.....	9½	9¼	West. Tel. & Tel. pfd..	—	50

PHILADELPHIA.

	Nov. 25	Dec. 3		Nov. 25	Dec. 3
American Railways.....	44	44	Phila. Electric	6¾	6⅞
Elec. Co. of America...	8	8⅛	Phila. Rapid Transit...	13	15¼
Elec. Storage Battery..	—	32½	Phila. Traction	82½	81
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Nov. 25	Dec. 3		Nov. 25	Dec. 3
Chicago City Ry.....150		150*	National Carbon	—	—
Commonwealth-Edison ..	—	78	National Carbon pfd...	—	—
Chicago Subway	—	14	Union Traction	—	—
Chicago Tel. Co.....	—	105	Union Traction pfd....	—	—
Metropolitan Elec. com.	19*	20*			

*Asked.

THE WESTINGHOUSE SITUATION.—The committee, acting at the request of certain creditors of the Westinghouse Electric & Manufacturing Company, has proposed the following plan for the extension of the company's debt: The holders of the floating debt of the company shall accept for their claims, including interest to Jan. 1, 1908, one-third in 5 per cent convertible bonds at 90, one-third in assenting stock of the company at par, and one-third in three 6 per cent notes of the company, in equal amounts, maturing respectively in one, two and three years from Jan. 1, 1908. The stock to be issued to creditors under this plan of extension shall be stock heretofore authorized by the stockholders of the company, and known as "assenting" stock. The convertible bonds to be issued under this agreement of extension are known as "convertible sinking fund 5 per cent gold bonds." They bear date of the thirtieth day of March, 1906, and the principal is payable Jan 1, 1931. The interest is at the rate of 5 per cent per annum, payable semi-annually on the first days of January and July in each year. They are issued under the provisions of a trust indenture bearing date of the thirtieth day of March, 1906, between the company and the Standard Trust Company of New York, as trustee. The trust indenture provides for the issue of bonds to the aggregate amount of $25,000,000, of which the sum of $1,969,000 is still reserved, to be issued only against the deposit of equal amounts of the outstanding 5 per cent debenture certificates issued by the Mercantile Trust Company; $22,345,000 of bonds have been certified by the Standard Trust Company, of which there are now outstanding $18,500,000, leaving $3,845,000 in the treasury and $686,000 yet subject to issue upon the payment into the treasury of the company of a like amount of money to be received from the sale of additional assenting stock. The notes to be issued will be in the form of ordinary notes, signed by the company and payable to the order of the depositors, and shall be dated Jan. 1, 1908, payable in one, two and three years from date, with interest at 6 per cent per annum, payable semi-annually, and shall have coupons attached representing said interest. While the depositors' claims are to be paid as aforesaid, one-third in stock, one-third in bonds and one-third in notes, it is understood and agreed that in cases where it is not possible to divide the depositors' claims into three equal amounts and to apportion the securities in precisely the proportion indicated, the committee shall have power to apportion stock, bonds and notes to the fractional part of the depositors' claims as the committee may deem best, providing for the extension of said fractional amounts in such a way as to approximate as closely as practicable to the scheme of this extension. The company agrees that as a condition to said plan becoming operative a majority of the members of its board of directors shall be persons approved in writing by the committee, and the company undertakes to cause the resignations of such of the present directors and the election of such new directors as shall be necessary to that end. It is stated from Pittsburg that developments indicate more strongly than ever that the receivers of the Westinghouse Electric & Manufacturing Company will be discharged in the near future, and that the company will be restored to the shareholders. The second plan for extending the debt of the company, it is expected, will be carried out. The details of the plan have not been made public as yet, but some announcement is anticipated in the near future. The shareholders are now co-operating with President Westinghouse and are working with the object of terminating the receivership as soon as possible.

A REVIEW OF WESTERN UNION.—With a longer unbroken dividend record behind it than any other security now active on the New York Stock Exchange, having paid not less than 5 per cent in any year since 1888 and dividends at a smaller rate even further back. Western Union has sold this week at a price to yield the buyer about 9 per cent. Last January it sold as high as 85; on Friday it sold at 54½. Its range in the year 1906 was from 94¼ to 83¾. There would seem to be, says the *Wall Street Journal*, a number of reasons for the reduced market position of the stock, apart from conditions affecting all investment securities at the present time. Coincidently with the declaration of the last quarterly dividend of 1¼ per cent, the company announced that it would discontinue quarterly statements of earnings. A great many people innocently inferred that the strike had made larger inroads upon the company's earnings than the management cared to acknowledge. Whether this inference was justified, only those having access to the accounts of the company can say. The weakness of the stock recently would tend, at all events, to confirm it, and to give rise at the same time to misgivings as to the dividend. Touching the condition of the company there have been no figures since those contained in the last annual report, as of June 30. They show that although the gross earnings for the fiscal year were the largest in the history of the company's business, and that the average receipts per message were the highest since 1884, the final result was a smaller aggregate of net earnings than for any year since 1900; net earnings last year, in fact, were smaller than in 1893 or in 1884. The average cost per message to the company was the highest since 1876. After dividends at the rate of 5 per cent on the stock, there was a surplus of income for the year amounting to $36,052. In November, 1906, $10,000,000 4 per cent convertible bonds (part of an authorized issue of $25,000,000) were offered to stockholders at 87½. On June 30, last, there had been issued of these new bonds $7,200,000, representing an increase of $288,000 a year in fixed charges. The income account, however, shows an increase in bond interest of only $92,086. That is approximately four months' interest on the new bonds, instead of eight. The bonds were dated Nov. 1, 1906. If the full interest for eight months had been deducted from income there would have been a deficit after dividends instead of a surplus of $36,052. The company has an accumulated surplus of $16,884,781, but it is not a cash surplus. It represents the excess of assets over liabilities in a bookkeeping sense. On June 30 it had $3,164,615 cash, and carried among its assets $2,889,799 sundry accounts receivable, an increase of $1,331,192 in that item for the year. On the other side of the balance sheet it showed bills payable, including the July dividend, amounting to $3,764,414.

WESTINGHOUSE ELECTRIC.—The receivers of the Westinghouse Electric & Manufacturing Company have issued a balance sheet as of Oct. 23, which shows a surplus of $11,610,756. They announce that they have taken pains to figure the assets down to a basis as conservative as possible. Their valuation of the total assets of the company is $82,817,923. Compared with a statement issued last spring, this is an increase of $10,600,000 in the value of the assets as shown in the annual report. The receivers believe that the assets are worth $10,600,000 more now than in March last. A large portion of the increase is explained by the increase in the value of the investments. In March the investments, including stocks and bonds in subsidiary companies throughout the world, were valued at $22,296,806. The receivers' valuations of these assets are now $29,490,614, an increase of about $7,200,000 since the panic began. On March 31, when the balance sheet was struck, the

company had a surplus of $12,595,151. According to the receivers' statement, the balance sheet as of Oct. 23 shows a surplus of $11,610,756. The business of the company continues on a very large scale, with a maintained percentage of profit.

NORTH SHORE ELECTRIC.—The annual report of the North Shore Electric Company, of Chicago, of which Samuel Insull is president, was issued a few days ago. After all charges, including $41,740 for depreciation, the balance of $85,024 was equal to 2.6 per cent on the outstanding capital stock. The financial statements follow:

	Sept. 30, 1907.	Sept. 30, 1906.
Gross earnings	$665,890	$544,242
Operating expenses and taxes	431,437	355,935
Net earnings	$234,453	$188,306
Bond interest	107,689	95,392
Surplus for year	$126,764	$92,914
Special depreciation reserve	41,740	
Balance	$85,024	
Previous surplus	169,100	
Total surplus	$254,124	
Less 6 per cent stock dividend	150,000	
Final surplus	$104,124	

President Insull, in his report to the shareholders, said among other things: "The growth of the company's business during the year, necessitating further enlargement of its distribution system, as well as the construction of additional substations, has called for an increase in the capital stock of $750,000 and in the outstanding first mortgage bonds of $604,000. Your directors are pleased to report that of the underlying bonds shown in the last annual report those which existed against the property acquired from the Calumet Lighting Company, amounting to $200,000, have been paid off and canceled. The operation of the contracts for furnishing power to street and interurban electric railways, which the company has recently made, is proving satisfactory, and there is reason to expect that this branch of the company's business will grow to large proportions. Your directors have deemed it wise to make a reduction of 10 per cent, effective Oct. 1, 1907, in the rates charged for residential lighting, and hope that the increase in the company's business will enable them in the future to make still further reductions."

STREET RAILWAY RECEIVERS.—Justice Seabury, of the New York Supreme Court, has appointed Paul Fuller, J. Hampden Dougherty and Melvin G. Palliser receivers of the New York City Railway Company and of the Metropolitan Street Railway Company, for which receivers had already been appointed in the Federal Court. The new receivers were appointed in actions brought by Attorney-General Jackson to dissolve the former corporation, and for an accounting of the official conduct of the directors of the Metropolitan Street Railway Company. The plan of the attorney-general is to fight the federal receivership to the United States Supreme Court if necessary. The three receivers are to be qualified in the sum of $100,000 each. Herbert R. Limburg has been appointed as their counsel. It is the intention of the receivers, as well as that of the attorney-general, to assert the jurisdiction of the state court as against the federal court, and by such action it is hoped a precedent will be set, and a final decision of the higher court obtained as to which of the courts, federal or state, may properly exercise jurisdiction. The ground on which the attorney-general seeks to dissolve the New York City Railway Company, by which it will forfeit its corporate rights, privileges and franchises, is that the company has been insolvent for at least a year. In regard to the Metropolitan Street Railway Company, the attorney-general demands an accounting from the directors for their official conduct from the year 1898 to the present time, including their alleged neglect or failure to perform their duties in the management and disposition of the property of the company. He also asks that they be directed to pay to the company all the money and the value of the property lost or wasted by or through their alleged neglect. The attorney-general in addition asks that the directors be suspended from exercising their office and that a new election of directors be held.

SAFETY INSULATED WIRE.—It was announced last week that Mr. H. E. Huntington has acquired a controlling interest in the $1,500,000 capital stock and $1,228,000 outstanding bonds of the Safety Insulated Wire & Cable Company, a subsidiary of the National Steel & Wire Company, which went into a receiver's hands some time ago. C. E. Graham, Mr. Huntington's personal representative in New York, has been elected vice-president of the Safety Insulated Wire & Cable Company. The company has a very large business and has sold vast quantities of cable to the United States Government.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company's statement of earnings for October and ten months compares as follows:

	1907.	1906.	1905.
October gross	$508,248	$449,559	$401,593
Expenses	303,837	270,867	240,387
October net	$204,411	$178,692	$161,566
Charges and taxes	37,998	35,726	28,924
October surplus	$166,413	$142,966	$132,642
Ten months' gross	4,854,036	4,416,256	3,796,456
Expenses	3,019,867	2,773,914	2,340,614
Ten months' net	$1,834,169	$1,642,342	$1,455,842
Charges and taxes	364,945	314,203	233,611
Ten months' surplus	$1,469,224	$1,328,139	$1,222,231

ELECTRICAL INVESTMENTS.—Stone & Webster, of Boston, have published opportunely a list of preferred stocks netting from 6 to 8 per cent, in well-established, dividend-paying public service corporations under their own management, for safe investment, and have issued a manual of electric traction, lighting and power properties, which will be mailed upon request to prospective investors. A good deal of similar work could be done advantageously at this time for other properties in getting the small investor interested in them and in getting their hoarded money into circulation.

NOT DUE TO BANKS.—President George Westinghouse, of the Westinghouse Electric Manufacturing Company, now in receivers' hands, has denied the published reports that the company's financial difficulties had been precipitated by big banking interests in New York. The appointment of the receivers, he stated, was an emergency measure taken on the advice of the Pittsburg Clearing House for the protection of all interests, the banks there being unable because of the financial stringency to co-operate with strong financial interests in New York, which had been prepared to extend the monetary aid needed.

FEWER NEW ENTERPRISES.—Capitalization of new companies incorporated with $1,000,000 capital and upwards in Maine, New Jersey, New York, Delaware and Massachusetts during November, according to the New York *Commercial*, was $42,000,000, compared with $52,050,000 in October and $184,900,000 in November, 1906. November incorporations were the lowest with one exception of any month in the last 15 years. There now appears to be a revival of activity in this direction, which will also be stimulated in the new year by the greater cheapness of money.

BELL TELEPHONE CONSOLIDATION.—At Philadelphia, on Dec. 3, at a special meeting of the Bell Telephone Company of Philadelphia it was decided to purchase the Pennsylvania Telephone Company and the Delaware & Atlantic Telegraph & Telephone Company of Pennsylvania. It was also decided to increase the capital stock of the Philadelphia Bell Company from $30,000,000 to $60,000,000, of which a sufficient amount will be issued necessary for the exchange of stock of the two companies acquired.

HUDSON RIVER POWER.—The Hudson River Electric Power Company reports income and expenditures for October as follows:

	1907.	1906.	CHANGES
October gross	$119,880	$76,774	$43,105 Inc.
Operating expenses	57,359	52,730	4,629 Inc.
Net	$62,521	$24,044	$38,476 Inc.

WIRELESS TELEPHONES.—An allotment of $25,000 for the purchase by the chief signal office of one or more dirigible balloons has been made by the board of ordnance and fortifications. An allotment of $3,000 also has been made for wireless telephones.

PAWTUCKET CONSOLIDATION.—A consolidation of the Pawtucket Electric Company, the Pawtucket Gas Company, and the Woonsocket Gas and Electric Companies, all of Rhode Island, is being carried out under the guidance of Stone & Webster, of Boston.

DIVIDENDS.—Directors of Canadian General Electric Company have declared the regular quarterly dividend of 2½ per cent. Directors of the Mackay Companies have declared the regular quarterly dividends of 1 per cent on the preferred and common stocks, payable Jan. 2.

GENERAL NEWS

Construction News.

TOMBSTONE, ARIZ.—The Adams Telephone & Telegraph Company, which was recently formed, will build a telephone line from Wilcox to Bowie, and west from Wilcox via Fort Grant and Bonita to the Klondike Camp.

CAMDEN, ARK.—The Camden Ice & Light Company has been organized by R. L. Moore and others.

HOT SPRINGS, ARK.—A resolution dissolving the corporate existence of the Southern Telephone & Telegraph Company, of this city, has been filed with the Secretary of State. The stockholders of the company are: H. J. Pettingill, J. E. Farnsworth, T. L. Powell, P. K. Baker, F. B. DeShon and W. J. Terry.

SULPHUR SPRINGS, ARK.—The Kihlberg Company, of which E. Bee Guthrey is secretary, will install an electric light plant. Smith & Powers, engineers, will have charge of the work.

GILROY, CAL.—The Union Construction Company, for the Stanislaus Electric Light & Power Company, is shipping material for the construction of transmission towers near the line of the Southern Pacific Company's tracks, the objective point being the cement works at San Juan, which it has contracted to reach by July 1, 1908.

HANFORD, CAL.—F. S. Granger has placed an order with the H. W. Johns-Manville Company, of San Francisco, for overhead equipment for 17 miles of electric railway.

KELSEYVILLE, CAL.—The Lake County Power Company has been organized for the purpose of taking over the old corporation formed two years ago to provide the city with electricity for lighting and gas for fuel. The company expects to have both plants in operation within 45 days. It has secured quarters at Lakeport, and later will establish a sub-station in that city. The men interested in the new company are George P. Low, of San Francisco; G. S. Cutler, of Calistoga; Robert Polk, of Upper Lake; M. S. Sayre and B. H. Henderson, of Lakeport. The men who relinquished their interest in the old company were W. M. Nobles, Joseph McLaughlin, Dr. W. B. Prather, Lewis Henderson, W. H. Renfro and L. H. Boggs.

LODI, CAL.—Henry E. Adams, manager of the Stockton Gas & Electric Company, states that the corporation of which his company is a part, will build a transmission line from Sacramento to Stockton, passing through Lodi, Acampo, Galt, Elk Grove and Florin, and will furnish electricity in competition with the American River Electric Company. This new line, while extending the service to a new field, will constitute a third main to supply power to Stockton should the other two lines be disabled.

LOS ANGELES, CAL.—Incorporation papers for the Los Angeles Gas & Electric Company are now being prepared. The capital stock will be $200,000. H. F. Lenkfield is the originator. It is proposed to expend $120,000 in the northeastern part of the city.

LOS ANGELES, CAL.—The Kings River Power Company has given notice of the appropriation of 25,000 miners' inches of water from the Kings River for the generation of electricity, the power house to be located on Section 35-12-28. The company will transmit electricity to Fresno, San Francisco and Los Angeles.

LOS ANGELES, CAL.—L. C. Brand asks the city of Glendale to pay $21,000 for his entire electric light and power system. The plant is said to be on a paying basis, but in order to give service wherever required it would be necessary to make considerable additions to the lines. It would probably require a bond issue of $. 000 to purchase the plant and make the needed extensions.

LOS ANGELES, CAL.—We are informed that the Los Angeles & Owens Valley Railroad Company, which proposes to construct a railway to connect Los Angeles, Randsburg, Independence and Bishop, will begin work on the construction of the road about April 1, 1908. The railway will be about 325 miles long and will be operated by electricity. The company will also furnish electricity for light and motors to towns and mines along the route. The officers of the company are S. P. Jewett, president; George Chaffey, vice-president, and A. M. Chaffey, secretary and treasurer.

SAN BERNARDINO, CAL.—Owing to an entire mountain side sliding to the bed of the Santa Ana River two power plants in the Santa Ana Canyon belonging to the Edison Power Company have been put out of commission. A large portion of the tunnel was carried down the mountain, besides wrecking flumes and water pipes.

SAN FRANCISCO, CAL.—Advices from Washington are to the effect that the Big Creek Gold Mining Company, of Bangor, Maine, has been granted a permit to occupy 20 acres for a power house in the Stanislaus (Cal.) national forest and a right of way for a pipe line. The company proposes to generate electric power. A permit has also been granted the North Mountain Power Company, of Junction City, Cal., to occupy an electric transmission line right of way 27 miles long in the Trinity national forest.

SAN FRANCISCO, CAL.—The City Electric Company, which is about ready to place in operation a new light and power plant in San Francisco, has closed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for a 10,000-hp turbo-generator. Two smaller generators of the same type are now in use by the company. The United Railroads expects to obtain power from this company for running its cars, and the capacity of the plant is being increased for that purpose.

VALLEJO, CAL.—The Vallejo & Northern Railway Company is making arrangements to begin construction work in the spring of 1908 on its electric railway, which is to connect Vallejo, Napa Junction, Creston, Cordelia, Sinsun, Fairfield, Cement, Vacaville, Winters, Woodland and Sacramento. All franchises and terminal sites and a large portion of the right of way have already been secured. The road will be about 130 miles long. Energy will be obtained from the Bay Counties Power Company, and both third-rail and overhead trolley will be used. The officers of the company are Melville Dozier, of Oakland, president and engineer; C. F. Kinsey, of Oakland, vice-president; T. T. C. Gregory, of Fairfield, secretary, and George S. Lockie, of Oakland, treasurer.

DENVER, COL.—A. E. Wilson, of this city, is interested in a project to build a large power plant on the South Platte River, a short distance south of Denver. It is proposed to develop 20,000 horse-power. The cost of the plant will be about $1,000,000.

WATERBURY, CONN.—John H. Cassidy, secretary of the Waterbury & Milldale Tramway Company, states that the company will award the contract for the construction of the road as soon as the capital is raised. The proposed railway will be operated by electricity and will connect Waterbury, Southington and Meriden. The line will be about eight miles long. The officers of the company are Charles H. Clark, of Milldale, president; John H. Cassidy, of Waterbury, secretary, and Edwin S. Todd, of Milldale, treasurer.

WASHINGTON, D. C.—Announcement has been made that the Washington, Spa Springs & Gretta Electric Railway Company will commence construction work in January, 1908. The railway will connect Washington, Bladensburg and Branchville and will be about eight miles long. The power station will be built at Beverly, Md. S. S. Yoder, of Washington, is vice-president and general manager.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 17, to furnish at the Navy Yard, Mare Island, Cal., naval supplies and a motor as per Schedule 488. Applications for proposals should designate the schedule desired by number. Blank proposals will be furnished upon application to the Navy Yard Pay Office, San Francisco, or to the bureau. E. P. Rogers is paymaster-general, U. S. N.

WASHINGTON, D. C.—Rear Admiral R. C. Hollyday, chief of Bureau of Yards and Docks, in his annual report recommends an appropriation of $985,047 for the Washington Navy Yard, which includes rewiring of certain yard buildings, at a cost of $21,500; machinery for power plant extension, $12,000; extension of underground conduit system, $10,000; extension to electric light plant, $5,000; extension and improvement to electric fire alarm and telephone systems, $4,000; complete switchboard in power plant in building No. 118, $2,500. The report also asks for $786,800 for improvements at the Mare Island Navy Yard, which includes $385,000 for the installation of a central power plant. The yard is now purchasing its power from an outside company.

JACKSONVILLE, FLA.—Bids will be received by the Lester Clay Company for constructing an electric light plant, which will furnish from 75 to 100 lamps.

LEESBURG, FLA.—The question of holding an election to vote on the proposition of issuing bonds to establish an electric light plant is now under consideration.

BARNESVILLE, GA.—An election will be held Dec. 31 to vote on the proposition of issuing $4,000 in bonds to enlarge the municipal electric light plant.

BLUE RIDGE, GA.—The citizens have voted to issue $30,000 in bonds for improvements to the electric light plant and water works system.

COLUMBUS, GA.—The Swift spinning mills, which will soon be placed in operation will be operated by electricity transmitted from a dam on the Chattahoochee River, owned by the Columbus Power Company.

MACON, GA.—The Citizens' Electric Company has withdrawn its application for a franchise to furnish electricity for lighting and power for manufacturing purposes, but contemplates making a new application later on. W. A. Burney, Savannah, Ga., is president.

WALKERSVILLE, GA.—Plans are being considered for the organization of a company to furnish electricity for lighting the city. A committee has been appointed consisting of Dr. J. D. Nicodemus, Cephas M. Thomas, Newton A. Fulton and others.

ELK CITY, IDAHO.—Plans have been drawn for a large power plant to be built on the south fork of the Clearwater River, near the mouth of Ten Mile Creek, near Elk City and the Orogrande mining districts. Jacob Schlosser, president of the Umatilla Mining Company, which owns

the Umatilla Mine, near Orogrande, is interested in the enterprise. Mr. Schlosser and his associates will organize a separate company to develop the water power, which will furnish electricity to run the Umatilla Mine, and also supply the Buffalo Hump, Orogrande and Elk City mining districts with electric power. The plant will have a maximum capacity of 10,000 horse-power and will cost about $140,000.

HAILEY, IDAHO.—The Idaho Consolidated Mines are contemplating the construction of an electric light and power plant to furnish electricity for the mines. Work has commenced on the construction of a dam across the Wood River. The cost of the plant is estimated at $50,000.

CHICAGO, ILL.—The Dearborn Street Improvement Association will soon ask for bids for the installation of the new electric lighting system from Van Buren Street to the river.

DECATUR, ILL.—The Wabash Railway Company will install an electric plant for lighting the station and roundhouse, and will also furnish electricity for lighting in the city.

ROCKFORD, ILL.—Arrangements are being made by the Central Union Telephone Company to place its wires underground along certain streets in this city.

ROCKFORD, ILL.—The Rockford Edison Company has changed its name to the Rockford Electric Company, and increased the capital stock of the company from $350,000 to $1,000,000.

CONVERSE, IND.—It is reported that O. D. Ross, of Peru, and Philip H. Palmer, of Kokomo, have taken an inventory of the local lighting plant owned by Lewis Barger, and have placed the value of the plant at $14,404. F. Wilson, of Marion, has a claim against the plant for $10,000, and the property will be sold at sheriff's sale.

EVANSVILLE, IND.—The American Bell Telephone Company has been granted a franchise to remove its offices from the Outer First Avenue to a site within the city limits. The company has agreed to construct a building to cost $100,000 in which its exchange and offices will be installed.

EVANSVILLE, IND.—A movement is on foot in this city to secure a municipal electric lighting plant. Mayor Boehne in his fight for better gas and electric light service called the Merchants' Association to his aid and is advocating the establishment of a municipal plant. The Merchants' Association passed a resolution in support of the mayor's effort to secure better lighting service and also to secure a municipal plant.

INDIANAPOLIS, IND.—Official announcement has been made that arrangements have been made whereby the work on the Indianapolis, Newcastle & Toledo Traction Company's will be resumed at once and pushed to completion. It is stated that the work of installing machinery in the power house will begin early this month.

MODOC, IND.—The capital stock of the Modoc Telephone Company has been increased from $5,000 to $10,000. J. G. W. Beard is secretary of the company.

SOUTH BEND, IND.—The South Bend & Southern Michigan Railway Company and the Indiana & Michigan Electric Company have closed a deal whereby the latter company will furnish power to operate cars of the former between South Bend and St. Joseph, Mich. The contract will take effect as soon as the new dam on the St. Joseph River at Berrien Springs, Mich., is completed. This will mean the abandonment of the steam power station at Scottdale. Four sub-stations will be erected along the line of the railway.

DAVENPORT, IA.—The McCarthy Improvement Company has commenced work on the new electric light plant of the Independent Gas & Electric Company in West Davenport.

DIKE, IA.—The Corn Belt Telephone Exchange Company contemplates making improvements to the local exchange.

DOUGHERTY, IA.—The Rockwell Farmers' Telephone Company is contemplating the establishment of a local and rural telephone exchange.

HUMBOLDT, IA.—The Rural Union Telephone Company contemplates installing a new switchboard in the local telephone exchange.

IDA GROVE, IA.—At a special election held recently the citizens voted to grant a 15-year franchise to the Ida Grove Electric Company to maintain a lighting and heating plant. The company contemplates making many improvements and extensions to its plant next year.

KEOSAUQUA, IA.—We are informed that J. W. Andrews, 7 Pine Street, New York, N. Y., has been appointed engineer for the two dams to be constructed on the Des Moines River for power purposes, which will cost about $500,000. D. Fitzgerald, 80 Wall Street, New York, N. Y., is also interested in the enterprise.

MUSCATINE, IA.—The Mississippi Valley Telephone Company contemplates making improvements to the local system, including the construction of a new building next season.

STORM LAKE, IA.—The Northern Telephone Company contemplates making improvements to its local exchange to cost about $1,500.

ALMA, KAN.—The Alma Light & Ice Company contemplates the installation of an electric light and ice plant and giving a 24-hour service. W. B. Wilson is manager.

LOUISVILLE, KY.—Contracts have been awarded to the General Electric Company by the Kentucky Electric Company for the construction of three turbo-generator sets having a combined rating of 2300 horse-power. Donald McDonald is president of the Kentucky Electric Company.

FRANKLIN, LA.—Poles have been placed and wires are being strung for the new electric plant which is expected to be completed and in operation by Jan. 1. All the principal streets will be lighted by arc lamps.

NEW ORLEANS, LA.—Plans and specifications have been prepared by J. W. T. Stephens, a civil engineer, for an electric railway to run from Algiers, New Orleans, to Grand Isle. Mr. Stephens proposes to organize a company and obtain a charter for the purpose of building and operating the line. The company is to be capitalized at $1,000,000.

PONCHATOULA, LA.—The Ponchatoula Electric Light Company is making arrangements to install a complete new plant by next January, the equipment of which will consist of a 60-kw alternator, a 125-hp engine and a boiler of 150 horse-power, and will also install transformers and arc lamps. S. Bowling is manager.

BANGOR, ME.—Construction work on the power transmission line from Ellsworth to Veazie, which has been under way at the Bangor end for some time, has been suspended until spring. The suspension of the work will in no way affect the preliminary work of surveys and obtaining right of way at the Ellsworth end of the line.

LEWISTON, ME.—The Libbey & Dingley Company has secured a 20-year lease of the water power at Littlesfield, on the Androscoggin River, near Auburn, known as the Damren & Leavitt power. The company proposes to build a concrete dam and install a power plant capable of developing 2000 horse-power. In addition to this a generator is to be placed at the power site above the Barker Mill dam, which will furnish about 500 horse-power additional for the company on the Little Androscoggin River.

PORTLAND, ME.—The City Council has authorized the renewal of the city's contract with the Portland Electric Light & Power Company for street lighting for a period of five years.

BOSTON, MASS.—An appropriation of $435,800 has been asked for by the Bureau of Yards and Docks for the Boston Navy Yard, which include extensions to the power plant, at $295,000; electric elevators, $17,000; underground conduit system, $30,800; telephone system extensions, $2,000. Rear Admiral Hollyday is chief of Bureau and Docks.

CHELMSFORD, MASS.—The Lowell Electric Light Corporation has applied to the Selectmen for permission to erect a transmission line from the north side of Princeton Street, near the city line, to Gay Street, near the mills of the Moore Spinning Company, in North Chelmsford. The company is making arrangements to furnish electricity to the Moore Spinning Company to operate its mills.

LEICESTER, MASS.—The Worcester Electric Light Company has purchased a site on Pleasant Street, where it will install an electric light station to operate its system in Leicester. The company will furnish a 24-hour service.

ESCANABA, MICH.—The Home Electric Company has been organized here by John H. Knutsen.

ESCANABA, MICH.—The City Council has accepted the proposition submitted by the Escanaba Electric Pulp & Power Company to furnish electricity to operate the municipal electric lighting plant for a term of 10 years.

FLINT, MICH.—The City Council has passed a resolution ordering the Valley Telephone Company to remove its wires from the streets and place them in underground conduits in the north end of the city, in accordance with a resolution passed by the Council in 1905. The telephone company has been given 15 days to start the work.

FLUSHING, MICH.—The Common Council has decided to purchase another engine for the municipal electric light plant.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company has commenced work on another large dam 8 miles north of the second dam at Croton. The new dam will have a 54-ft. head and develop 15,000 horse-power. The plant will be connected with the general system of the power company, which supplies Grand Rapids, Muskegon and other western Michigan cities with power. Work of construction is to begin at an early date. J. B. Foote is engineer.

GRAND HAVEN, MICH.—The city of Grand Haven must either spend about $15,000 in improving its lighting plant and extending the service or abandon the plant and purchase electricity to operate the municipal system. There is strong sentiment for buying power of the Grand Rapids-Muskegon Power Company.

JACKSON, MICH.—The Commonwealth Power Company contemplates the construction of a new dam across the Kalamazoo River just above Allegan. It will supplement the five dams already built at Allegan, Otsego, Trowbridge and Ceresco, and the new one at Webers, on the Grand River. In addition to these stations the company has smaller stations at Albion and Battle Creek, while at Jackson steam turbines furnish 6000 horse-power, and a steam plant generating 1000 horse-power is being installed at Battle Creek. The proposed new dam will generate 2500 horse-power, bringing the output up to approximately 17,000 horse-power.

KALAMAZOO, MICH.—The Kalamazoo Home Telephone Company is preparing to place its wires in underground conduits.

LANSING, MICH.—The Michigan Power Company contemplates extending its lines from Lansing to Charlotte, and will soon apply to the City Council of Charlotte for a franchise in the city. The company will erect a transmission line from its power plant in Dimondale to Charlotte, the cost of which is estimated at $75,000.

LUDINGTON, MICH.—The Pere Marquette Railroad Company, which nine years ago installed an electric plant for power and lighting for its

docks in Ludington, at a cost of $20,000, has sold the plant and will buy energy from the Stearns Lighting & Power Company.

TRENTON, MICH.—As soon as arrangements can be completed the Village Council will issue a call for a special election for the taxpayers to vote on the proposition to sell the village electric light plant and water works system to the Edison Illuminating Company, of Detroit, for $8,000. If it is decided to sell, the Council will give the company a ten-year contract for a water supply and for street lighting. The Edison company, it is said, plans to install an extensive electric lighting and power system between Trenton and Ypsilanti and will extend its transmission line from the Ypsilanti plant and supply all the towns on the route with electricity, and will extend the water works service to Grosse Isle.

ALEXANDRIA, MINN.—The question of making improvements to the municipal electric light plant is under consideration.

CANNON FALLS, MINN.—The new electric light plant, which is being erected to take the place of the plant burned about a year ago, is nearly completed and will soon be put in operation.

FARIBAULT, MINN.—Receiver S. F. Donaldson, of the First National Bank, has sold the plant of the Polar Star Electric Light Company in this city to F. C. Nelson, of St. Paul. The receiver of the bank received $1,000 for the bank's share in the plant. Mr. Nelson assumes the payment of $36,000 in bonds against the plant. It is said that he will make extensive improvements to the plant.

MINNEAPOLIS, MINN.—Joseph Kiichli, the local promoter of the Minnesota Power & Trolley Company, has relinquished his rights in the company to Archibald S. White, of New York, N. Y. The company proposes to build a dam on the Mississippi at Monticello and Otsego and generate electricity which will be transmitted to Minneapolis. The company recently received a franchise to distribute electricity for motors and heaters in this city. It is understood that Mr. White will begin active work in the spring. The charter is to be forfeited if the dam is not completed by Dec. 31, 1908.

WINONA, MINN.—The Winona Railway & Light Company is planning to install a 450-hp boiler.

BAY ST. LOUIS, MISS.—The local telephone exchange of the Cumberland Telephone Company was recently destroyed by fire.

HOUSTON, MISS.—The citizens are considering the question of increasing the capacity of the municipal electric light plant and will install a 120-kw, alternating-current, 60-cycle, 2200-volt generator direct connected. J. C. Arnold is manager.

SEMINARY, MISS.—The People's Telephone Company has just completed the local telephone system and contemplates extending its lines to Hattiesburg, Collins and Mount Olive.

NEOSHO, MO.—The Neosho Electric Light Company contemplates the installation of a 500-hp water tube boiler in its plant. S. N. Carver is manager.

DILLON, MONT.—It is reported that the two electric light and power plants in Dillon have been consolidated.

GRAND ISLAND, NEB.—T. H. Fritts, manager of the Grand Island Electric Company, writes that the company is contemplating increasing the equipment of its plant by the installation of a 300-kw steam turbo-generator set, cooling tower and pumps complete.

YORK, NEB.—Owing to the increased demand for electricity the York Light & Power Company has been obliged to increase the output of its plant, and is installing a new engine and has placed an order for another generator.

CARSON, NEV.—An agreement has been entered into between the Pacific Telephone & Telegraph Company and the Nevada Consolidated Telephone & Telegraph Company, whereby the latter will take over the entire system of the former in its territory. The new company has announced that it will operate its system under the new franchise, and that it will give 2 per cent of its earnings to this city. Manager Heidenrich will be retained by the new company. Announcement has also been made that the new concern has purchased all the Alpine Telephone Company's lines, which extend over Douglas, Alpine and Mono Counties. J. F. Adams is president of the company and is arranging for the installation of modern equipment.

ELY, NEV.—O. J. McConnell has applied to the Board of County Commissioners for a franchise for an electric railway to extend from the smelter and covering all the streets of the city of Ely.

GOLDFIELD, NEV.—A syndicate of Baltimore capitalists, headed by H. G. Merry, has recently acquired a group of copper properties in the Ubehebe Mountains, and has decided to build an electric railway from Bonnie Claire station, on the Tonopah & Goldfield Railroad, to its mines, a distance of 50 miles.

PORTSMOUTH, N. H.—An appropriation of $871,350 has been asked for by the Bureau of Yards and Docks for improvements to the Portsmouth Navy Yard during the next fiscal year which includes, extension to electric light plant, $20,000; cranes for boiler shop No. 96, $20,000; steam main, central power plant to steam engineer plant, $9,000. Rear Admiral R. C. Hollyday is chief of Bureau of Yards and Docks.

MORRISTOWN, N. J.—The Public Service Corporation has secured the lighting contract for Morris Township, in connection with the Morris & Somerset Electric Company. The contract is for 48 incandescent lamps of 25 candle power at $18 per year.

PRINCETON, N. J.—The Trustees of the Princeton Theological Seminary contemplate installing a heating and lighting plant.

BERGEN, N. Y.—Temporary arrangements have been made for running of the electric light plant, which is owned by individuals who decline to run it longer, until the annual election, March 17. The Village Board has agreed to run it, provided enough money should be raised by subscription to make up the difference in the income from individuals and firms for light, plus the amount allowed by law for street lighting and the cost of running the plant, the estimated difference being about $40 a month. It is expected that the full amount will be raised. The streets have been lighted by electricity since July, 1901.

BROOKLYN, N. Y.—Bids will be received until Dec. 10 by John H. O'Brien, commissioner of water supply, gas and electricity, New York City, for furnishing from Jan. 1, to Dec. 31, 1908, in the borough of Brooklyn, electricity and maintaining electric lamps for lighting the streets, avenues, public buildings, parks and public places.

GOUVERNEUR, N. Y.—It is expected that the Tannawa Falls Electric Company will soon begin the work of extending its transmission lines within the village. The line from Hermon is completed. The company will be ready for business as soon as the sub-station is completed and the lines erected, which will be about Jan. 1.

LOCKPORT, N. Y.—The merger of the Lockport Gas & Electric Light Company and the Economy Light, Fuel & Power Company has been effected, and the new company, the Lockport Light, Heat & Power Company, will take over the properties on Jan. 1. Oliver M. Diall, present superintendent of the Lockport Gas & Electric Company, will be general manager of the new company.

NEW YORK, N. Y.—Bids will be received until Dec. 10 by John H. O'Brien, commissioner water supply, gas and electricity, New York City, to furnish to the boroughs of Manhattan, Bronx, Queens and Richmond from Jan. 1 to Dec. 31, 1908, inclusive, electricity and maintaining electric lamps for lighting streets, avenues, public buildings, parks and public places.

GASTONIA, N. C.—An appropriation of $2,000 has been made for improving the electric lighting system of the town.

KINGS MOUNTAIN, N. C.—Harkey & Page, electrical contractors, of Charlotte, have been awarded the contract for installing the new electric lighting system in this place. Electricity for operating the system will be supplied by the Southern Power Company, of Charlotte, N. C.

WASHBURN, N. D.—The Northwestern Telephone Company has been granted franchises for a telephone line through the towns of Martin, Mercer and Turtle Lake.

AKRON, OHIO.—Application has been made to the Secretary of State for a charter for the Akron & Youngstown Electric Railroad Company. The company has an authorized capital stock of $100,000 and is headed by Thomas L. Childs, of Akron.

ASHEVILLE, OHIO.—Bids will be received by W. P. Powell, village clerk, until Dec. 20, for furnishing all material, copper wire and arc lamps and constructing an electric street lighting system to be operated in connection with the sub-station of the Scioto Valley Traction Company. Specifications may be obtained from R. Fullerton, care of the Scioto Valley Traction Company, Columbus.

MANSFIELD, OHIO.—The directors of the Mansfield Railway, Light & Power Company have decided to increase the output at the power house to provide power for the Ashland line when completed. The cost of the work is estimated at $100,000.

STEUBENVILLE, OHIO.—The County Commissioners have granted the Knoxville Rural Telephone Company a franchise for a right of way between Knoxville and Osage by the way of Toronto, Empire and New Somerset pikes.

TOLEDO, OHIO.—The Toledo Railways & Light Company has been granted a six-year franchise to operate a street railway on Holland Street and Oakdale Avenue, East Toledo.

XENIA, OHIO.—The Trustees of the Ohio Soldiers' and Sailors' Orphans' Home, in their annual report, ask for a special legislative appropriation of $100,000 to install a complete new power plant and sewerage system.

MEDFORD, ORE.—The Rogue River Electric Company has been formed to take over the plant and holdings of the Condor Water & Power Company, including the dam and power house at Gold Ray, and the light and power system extending through the Rogue Valley, supplying electricity to the towns of Grants Pass, Gold Hill, Central Point, Medford, Jacksonville and Ashland. The capital stock of the company is $700,000, and the incorporators are C. R. Ray, president; H. C. Stoddard, secretary, and W. G. Aldenhagen.

PORTLAND, ORE.—The Portland Railway, Light & Power Company plans to develop the water power of Little White Salmon River in Washington and generate electricity to be transmitted to Portland, a distance of about 60 miles. The site was purchased by the old City & Suburban Railway Company and came into possession of the present company through the consolidation of the old companies. It is estimated that from 25,000 to 30,000 horse power can be developed.

HAZLETON, PA.—The Harwood Electric Power Company is extending its transmission lines to Lattimer and will furnish electricity for lighting the streets and residences of the villages and for operating the mines. Electric locomotives will be used for hauling coal, and later electricity will be used for operating the breaker machinery. The Harwood and Lattimer collieries, controlled by Calvin Pardee and Sons, will be

operated by electric energy. G. B. Markle & Company also have extensive plans for the use of electricity in the operation of their mines.

JOHNSTOWN, PA.—The City Council has granted the Johnstown Passenger Railway Company a franchise to operate its system on certain streets in Morrellville.

NEW CASTLE, PA.—Surveys are being made for a new electric railway between this city and Beaver Falls, and it is said that work will commence on the construction of the road early in the spring. Charters for the proposed line have been secured, one through Wampum, and the other for a spur from Wampum to Ellwood City. The New Castle & Wampum Company and the Wampum & Beaver Falls Company will be consolidated and will reach New Castle by the way of Mahoningtown, where connection will be made with local lines. Pittsburg, Ellwood City and Zelinople capitalists are interested in the proposed company.

PITTSBURG, PA.—The power house of the Pittsburg Malleable Iron Company, at Fourth and Smallman streets, was recently destroyed by fire, causing a loss of $15,000.

PITTSBURG, PA.—The Pennsylvania & Franklin Street Railway Company and the Electric Avenue Street Railway Company have been consolidated. The new company has a capital stock of $14,000, and is building an independent line between Wilkinsburg and East Pittsburg. Henry P. Haas is president and George H. Finn is secretary, all of Pittsburg.

SHAMOKIN, PA.—The Shamokin & Coal Township Light & Power Company has agreed to furnish electricity for operating the new Selinsgrove Electric Railway Company and will also furnish electricity to light the residences along the way. It is expected that work will soon commence on the erection of the lines. The local plant with the installation of new engines will be able to furnish power as far as Williamsport.

GREENVILLE, S. C.—The Greenville Interurban Company has commenced a survey of its proposed electric railway from Williamston to Greenville, and is now securing rights of way for another line, which it proposes to build from Greenville to Spartansburg. It is announced that the company has completed all arrangements for financing the enterprise. John C. Carey is president of the company.

SUMTER, S. C.—J. L. Alnut is reported to have petitioned the City Council for a franchise to operate a street railway and gas works.

FLANDREAU, S. D.—We are informed that the Flandreau Water Power Company is considering the question of constructing an electric light plant to be operated by water power. It is proposed to organize a stock company and a practical man is wanted to take stock in the company and look over the field and make an estimate of the cost of the plant.

MADISON, S. D.—Plans are now being considered for increasing the output of the municipal electric light plant, which will include the installation of two 80-hp tubular boilers; one 65-kw alternating-current generator with exciter, and also changes on the switchboard. W. A. Boyd is manager.

LIMESTONE, TENN.—W. N. Mitchell is contemplating the installation of an electric light plant to furnish electricity to light the town.

BEAUMONT, TEX.—The Southwestern Telephone & Telegraph Company has submitted a proposition to the City Council agreeing to install underground conduits and double metallic system in Beaumont, and to make extensive improvements in its local plant and exchange, provided the City Council will grant the company a new franchise for a term of 25 years, for which the company agrees to pay the city $250 per annum and will install a special conduit for the city fire alarm or police system.

SAN SABA, TEX.—The San Saba Light, Ice & Bottling Works Company is contemplating the installation of a gas producer engine or oil engine to operate its lighting plant. Frank B. Hall is manager.

SALT LAKE CITY, UTAH.—It is officially announced that the special lighting committee of the City Council, which has been considering the question of improving the present street lighting system, has accepted the proposition submitted by the Utah Light & Railway Company. The new lighting system will require new arc lamps to take the place of the old-fashion type now in use. Incandescent lamps will be used along the boulevard and on the north beach.

MIDDLEBURY, VT.—The Middlebury Electric Company is replacing its gasoline engine with a Westinghouse compound steam engine of 170 hp, which will be used in conjunction with the new turbine water wheel. When the improvements are completed the company will be in a position to meet all demands made upon it.

AMHERST, VA.—O. V. Hauger, secretary of the Amherst Electric Light & Power Company, writes that the company has been organized to build an electric light plant and will in about ten days decide on the size of its proposed plant, etc. It is proposed to operate the plant by water power if possible.

NORFOLK, VA.—It is reported that the Portsmouth Marine Railway Company is negotiating for the purchase of the Dashiell property in the Berkley Ward, and, if the deal is closed, will remove its plant, which is now located in Portsmouth, to Berkley, where it will be improved and enlarged.

RICHMOND, VA.—The receiver of the Virginia Passenger & Power Company, under authority of the federal court, is preparing to spend $250,000 for improvements in its power station and for building a new sub-station to increase the output. The output of the power plant will be increased to 12,000 horse-power. A new engine, the largest in the South, is provided for the Twelfth Street plant. The sub-station will be on Broad Street between Shaffer and Harrison Streets.

STAUNTON, VA.—The Blue Ridge Light & Power Company has placed on record a deed of trust to J. M. Perry, trustee, to secure an issue of $100,000 in bonds, the proceeds to be used to cover floating indebtedness.

TAZEVILLE, VA.—The local exchange of the Bluefield Telephone Company was recently destroyed by fire, causing a loss of $3,000.

BISMARCK, WASH.—The Bismarck Mill Company is contemplating installing a steam power plant for the generation of electricity to supply the suburbs of Tacoma.

CENTRALIA, WASH.—The City Council has granted the promoters of the Centralia-Chehalis Electric & Power Company an extension of 60 days in which to deposit the $1,000 guarantee money and to commence work. The delay has been caused by the recent financial flurry. The City Council of Chehalis has also granted the company an extension of time.

MONROE, WASH.—The Monroe Water & Light Company is contemplating extensive improvements to its system, and will install a new engine, boiler and generator in its power plant and erect about 4½ miles of line. R. V. Green is manager.

NORTH YAKIMA, WASH.—In addition to the large irrigation project on the Columbia River, at Priest Rapids, the Hanford Irrigation Company has completed surveys for an electric railway from Hanford to North Yakima to a point where it will connect with the Milwaukee Railway further west.

NORTH YAKIMA, WASH.—The new power plant of the Northwest Light & Water Company, about 12 miles from North Yakima, in the Naches River Valley, has been placed in operation, and is furnishing 3500 horse power with the present equipment, and is capable of developing 7000 horse power. With the opening of the new plant announcement has been made that the company will supply electricity for the Yakima Valley Transportation Company's lines when put in operation, and another sub-station will be built in this city. The company also proposes to furnish electrical energy for the various manufacturing plants near North Yakima and in the city, and will also extend its lighting system into the farming districts.

OLYMPIA, WASH.—The fire, light and water committee of the Council has been instructed to enter into a contract with the Olympia Light & Power Company to supply the city with electricity for street lighting for a term of three years.

PASCO, WASH.—William H. Perry has been appointed receiver of the Pasco Power & Light Company. Application for a receiver was made by F. T. Blunck, of Davenport, Ia., in his own behalf and that of other creditors, to protect and preserve the property of the company for the benefit of the creditors. He states that the company has unlimited resources, but cannot obtain funds to operate with on account of the stringency of the money market.

SEATTLE, WASH.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 17 for naval supplies to be furnished at the navy yard, Puget Sound, Wash., as follows: Schedule 513—electric wire, conduit, switchboard cabinets; schedule 515—cable, steel, copper pipe, etc.; schedule 517—incandescent lamps, etc. Applications for proposals should designate the schedule desired by number. Blank proposals will be furnished upon application to the navy pay office, Seattle, Wash., or to the bureau. E. B. Rogers is paymaster general.

TOPPENISH, WASH.—Everett Bohannon, who has the franchise for installing an electric light plant in Toppenish, has placed orders for machinery and poles necessary for a lighting system. Work will commence on the system as soon as the material arrives.

ELKINS, W. VA.—C. C. Bosworth, superintendent of the Valley Improvement Company, writes that the Valley Improvement will reorganize under the name of the Elkins Power Company and will build an entirely new plant, reconstruct its lines, etc. The company has secured a new franchise for 50 years, and the city contract for lighting has been extended for a term of 10 years. A new arc lighting system for street lighting will be installed as soon as the plant is ready to furnish current. The present 110-volt, single-phase, 60-cycle system will be replaced with a 2200-volt, three-phase system. Either coal or natural gas will be used for fuel. The company at present is operating under the name of the Valley Improvement Company.

ASHLAND, WIS.—A. E. Appleyard, head of the Chippewa Valley Construction Company, who recently entered into an agreement with the Council for the construction of a new street lighting plant and the development of the Copper Falls water power, will complete the organization of his new company, which will be known as the Ashland Power Company. He states that he completed financial arrangements for the proposition.

LA CROSSE, WIS.—The Winona City Council has passed an ordinance giving the La Crosse Water Power Company permission to erect its transmission lines from the Hatfield dam into the city over the high wagon bridge.

MINERAL POINT, WIS.—The Mineral Point Electric Company has filed an amendment to its charter increasing its capital stock from $25,000 to $50,000.

STANLEY, WIS.—The Northwestern Lumber Company has contracted with the city to furnish 26 electric lamps.

WITTENBERG, WIS.—The Viking Lumber Company has submitted a proposition to the Village Council to furnish the village with a certain number of arc lamps for street lighting. The company has also made a proposition to the village of Eland to furnish electricity for lighting.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has purchased a charter from William Farrell, S. G. Faulkner and the estate of the late Dr. Lefeyre, giving it the right to build an electric railway between Vancouver and the international boundary line, at or in the vicinity of Blaine. The company has also secured an option of purchase of water rights on the Lillooet River, which were secured two years ago by Hermon & Burwell, engineers, of Vancouver.

BELLAIRE, ONT.—A committee has been appointed by the Board of Trade to interview the officials of the Grand Trunk Railway in regard to the construction of an electric railway to the cement works.

GODERICH, ONT.—The Ontario & West Shore Railway contemplates the construction of an electric railway between Goderich and Owen Sound. The townships along the line will submit by-laws in the near future guaranteeing their share of the bonds of the road to be voted on soon. The cost of the road is estimated at $20,000 a mile.

HAMILTON, ONT.—The Hamilton Electric Radial Railway Company will ask the next session of Parliament for power to extend its lines to Toronto.

HAMILTON, ONT.—Application will be made at the next session of Parliament for an act to incorporate the Ontario & Michigan Power Company with the right to acquire and operate water powers on the Nipigon River and the Pigeon River in the Thunder Bay district.

HAMILTON, ONT.—The City Council has decided to submit the by-law to the people for the issue of debentures to the amount of $225,000 for the purpose of installing a municipal electric light plant. The Council also passed the second reading of the by-law to issue $50,000 in debentures for electric pumps for the new water works at the Beach.

HAMILTON, ONT.—J. Reid Hyde, of the Colonial Engineering Company, Ltd., of Montreal, Que., has submitted a proposition to the City Council for furnishing electricity for lighting the city. The company agrees to install a producer gas engine plant and furnish arc lamps for street lighting for $30 per lamp per year, and to furnish electricity for lighting and power purposes from one and one-half cents to two and one-half cents per kw-hour. The company is now installing a plant at Chatham.

INGERSOLL, ONT.—The public utilities committee of the City Council has made arrangements with Ross & Holgate, electrical engineers, of Montreal, Que., to furnish the Council with a valuation of the plant of the Ingersoll Electric Power & Light Company. The Council contemplates purchasing the plant to be operated by the town.

PARRY SOUND, ONT.—The Ontario Railway and Municipal Board has been asked to approve a by-law of the town of Parry Sound providing for the issuance of debentures for the purpose of extending and improving the electric light and water works system of the town.

ST. THOMAS, ONT.—Estimates have been submitted to the City Council by the Hydro-Electric Power Commission providing for a distributing plant costing $42,493. The estimates provide for the construction of two branch lines through the city.

TORONTO, ONT.—It is stated that if the city decides to install a municipal electric light plant the Cataract Power Company will ask for an opportunity to bid for furnishing power for operating the system.

TORONTO, ONT.—The Board of Control of Toronto proposes to construct an electric spur railway from Cherry to Leslie Street to feed the industries at Ashbridge's marsh. The cost of the work is estimated at $90,000.

TORONTO, ONT.—The Colonial Engineering Company, of Montreal, Que., has submitted complete plans to furnish a complete electric light and power station and equipment including all exterior and interior connections and appurtenances. The company guarantees to furnish and equip the plant and have it in successful operation within two years of the execution of the contract, for $2,875,000.

TORONTO, ONT.—The City Council on Nov. 25 voted to submit the by-law to the people in January, to provide for the issue of $2,750,000 in bonds for the construction of a plant to distribute the electric power to be supplied by the Hydro-Electric Power Commission from Niagara Falls. The plant will provide for 1500 street lamps, power to be delivered to pumping stations and for lighting of the public buildings.

TORONTO, ONT.—Estimates of the cost of electric power have been given by the Hydro-Electric Power Commission to the towns of Belleville, Kingston and Deseronto, which are outside of the Niagara power zone. The estimates presented are calculated on the basis of an offer of power made by the Northumberland Paper & Electric Company, of Campbellford. The prices are as follows for 24-hour service stepped down ready for distribution: For Belleville, a minimum of $30.44 to a maximum of $25.29 per horse-power per year; for Deseronto, $24.79 to $31.86; for Kingston, $24.81 to $28.60.

Company Elections.

HOPKINSVILLE, KY.—At the annual meeting of the Hopkinsville Home Telephone Company held recently, the following officers were elected for the following year: R. E. Cooper, president; W. T. Fowler, vice-president; J. T. Garnett, treasurer, and J. T. Edmunds, general counsel.

MURPHYSBORO, ILL.—The Murphysboro Electric Railway, Light, Heat & Power Company, which was recently organized to build an interurban railway between Murphysboro to Carbondale, has elected the following officers: P. H. Eisemeyer, president; W. C. Alexander, vice-president and manager; John G. Hardy, secretary and treasurer.

TRENTON, N. J.—At the annual meeting of the Interstate Telephone Company, held Nov. 25, the following officers were elected: H. R. Swartz, president; William S. Hancock, vice-president; Barker Gummere, secretary; C. W. Wright, treasurer, and F. A. Demarest, general superintendent.

New Industrial Companies.

AMBOS-CUDMORE COMPANY.—Mr. Walter P. Ambos, manufacturers' agent, and Mr. H. H. Cudmore, associated formerly with the Cleveland Electrical Supply Company, have incorporated the Ambos-Cudmore Company, with headquarters in the Citizens' Building, Cleveland. The new concern will act as selling agents for the Weston Electrical Instrument Company, the Bristol Company, W. H. Bristol, Condit Electrical Manufacturing Company, Steel City Electric Company, Enameled Metals Company, Machen & Mayer Electrical Manufacturing Company, Pass & Seymour, Duncan Electrical Manufacturing Company, Hartford Time Switch Company and the Detroit Insulated Wire Company. The firm will also handle switchboards.

THE CORNING MOTOR & ENGINE COMPANY, of Corning, N. Y., has filed articles of incorporation, with a capital stock of $50,000. The directors are: Charles C. Clark, Merrill S. Baker, of Corning, and Laverne J. Johnson, of Jamestown, N. Y.

THE REX ROTARY GAS ENGINE COMPANY, of Jersey City, N. J., has been incorporated, with a capital stock of $500,000, by Henry M. Black, Joseph W. Keffer and John J. Hogan.

THE STANDARD ELECTRIC HEADLIGHT COMPANY, of Indianapolis, Ind., has been incorporated, with a capital of $50,000. J. A. Overman, W. S. VanBuskirk and C. H. Lewis are the directors.

New Incorporations.

BIRMINGHAM, ALA.—The Oliver Electric Company has been incorporated with a capital stock of $6,000 by S. W. Oliver and others.

BOONEVILLE, ARK.—The Booneville Ice, Light & Cold Storage Company has been organized, with a capital stock of $50,000, by M. G. Latimer, G. A. Bryant and others.

TELLURIDE, COL.—Articles of incorporation have been filed for the Beaver River Power Company with the Secretary of State. The company proposes to generate and transmit electricity for light and power in Telluride. The officers of the company are: L. L. Nunn, president; L. B. Fuller, vice-president; Eldon P. Brown, secretary, and L. Bierbach, treasurer.

CARBONDALE, ILL.—The Citizens' Water, Light & Power Company, which is now being organized, will have a capital stock of $75,000. The incorporators are C. E. Hamilton, J. S. Lewis and L. R. Harrington.

KEOKUK, IA.—Articles of incorporation have been filed for the Keokuk & Columbus Junction Transit Company. The company is capitalized at $10,000, and the directors are J. E. Peterson, president; Ira W. Wells, W. J. Francey, Theodore Brinck, G. W. Mattern, D. B. Hamil, D. B. Weil and others.

WICHITA, KAN.—A company is being organized, to be known as the Wichita Light, Heat, Power & Space Company, for the purpose of furnishing heat, light and power to small manufacturers.

PADUCAH, KY.—Articles of incorporation have been filed for the Foreman Brothers Electric Company, with a capital stock of $20,000. The incorporators are S. E. Foreman and others.

PORTLAND, ME.—The American Transit Company has filed articles of incorporation with a capital stock of $260,000, by J. E. Menter, president, C. E. Eaton, clerk, and M. W. Baldwin, all of Portland.

FOWLERSVILLE, MICH.—The Fowlersville Light Company has been organized with a capital stock of $15,000. The incorporators are Lewis P. Cody, Amazon Antisdel and others.

OREGON, MO.—The Oregon Interurban Railway Company has made application to the Secretary of State for a certificate of incorporation with a capital stock of $60,000. The company proposes to build an electric railway from Oregon to Forest City, a distance of about six miles. The incorporators are: Benjamin F. Morgan, Lewis I. Moore, Charles D. Zook, William Derr, Henry C. Cook, William H. Richards and Daniel Zachmann.

ZANESVILLE, OHIO.—The Zanesville, Glenford, Columbus, New Lexington, Newark & Flint Ridge Coal Tramway Company has been incorporated with a capital stock of $7,750 by Col. Albert E. Boone, Quincy Leckrone, Harris Love, George F. Shrider and E. Lecrone.

OKLAHOMA CITY, OKLA.—The Oklahoma Interurban Traction Company has been incorporated with a capital stock of $500,000 to build an interurban electric railway in Oklahoma City and Capitol Hill to El Reno. The incorporators are L. E. Patterson, S. C. Glasgow, G. F. Benz, John H. Wright and Lee Hamilton.

TEMPLE, OKLA.—The Temple-Randlett-Eschlet Telephone Company has been incorporated with a capital of $6,000. The incorporators are: J. W. Adair, V. L. Adair, J. L. Little and M. L. Little.

MONONGAHELA, PA.—Articles of incorporation have been filed for the Monongahela & Carroll Street Railway Company with the Secretary of State. The company is capitalized at $12,000 and proposes to build an electric railway two miles long from Monongahela to Carroll. The directors are: E. B. Hartman, Jr., of Pittsburg, president; W. D. McBryan, E. W. Marshall, W. S. Walsh and W. E. Walsh.

PHILADELPHIA, PA.—The Equitable Electric Power Company has been granted a charter by Governor Stuart. The company proposes to supply light, heat and power in the city of Philadelphia. James Collins Jones, Bullitt Building, is treasurer of the company.

SHENANDOAH, PA.—The Farmers' Independent Telephone & Telegraph Company has been organized and a charter applied for by the farmers of Ringtown Valley. The company is capitalized at $5,000, and the directors are: Elmer Dennison, Alexander Manbeck, David Davis, David Horn, Alfred Teter and others.

WEST CHESTER, PA.—The West Chester & Wilmington Electric Railway Company has applied to the Secretary of State for a charter to build an electric railway along the West Chester and Wilmington Turnpike between the two cities, a distance of 18 miles. The company is capitalized at $54,000, and the officers are: T. E. O'Connell, president, and C. P. Faucett, treasurer.

GANN VALLEY, S. D.—The Buffalo County Telephone Company has been incorporated with a capital stock of $25,000 by J. V. Drips, Arthur G. Hill and George W. Frazer.

TREZEVANT, TENN.—The Trezevant Telephone Company has been organized for the purpose of establishing an independent system. O. C. Sloan was elected president and Nevins Arnold secretary.

BAIRD, TEX.—The Farmers' & Merchants' Gin, Light & Ice Company has been incorporated, with a capital stock of $5,000, by V. E. Jones, P. H. Crook and B. Graham.

AMHERST, VA.—The Amherst Electric Light & Power Company has been incorporated with a capital stock of $15,000 to establish an electric light and power plant. No contracts have yet been awarded for the work. The officers of the company are: H. L. Page, president; H. C. Joyner, vice-president; O. V. Hanger, secretary; and J. E. Bowman, treasurer.

WHEELING, W. VA.—The Mozart Improvement Company has filed articles of incorporation, with a capital stock of $10,000. The incorporators are Edmond M. Kirchner, Harry L. Hesse, Emma K. Kirchner, Elizabeth R. Hesse, all of Wheeling, and William R. Harper, of Bellaire. The company proposes to construct and maintain plants for generating electricity for heating, lighting and power purposes. The chief works of the company will be in Union District, Marshall County, W. Va.

COTTAGE GROVE, WIS.—The Cottage Grove Telephone Company has been incorporated, with a capital stock of $10,000, by H. G. Clark and others.

MILWAUKEE, WIS.—The Industrial Power Company has been incorporated with a capital stock of $120,000 by Cyril J. Atkinson and others.

NESHKORO, WIS.—Articles of incorporation have been filed for the Neshkoro Telephone Company with a capital stock of $2,000 by Charles T. Dahlke, J. F. Krueger and Charles A. Marks.

SEYMOUR, WIS.—The Culbert Valley Telephone Company has been organized and the following officers elected: J. J. Culbert, president and manager, and A. L. Clark, secretary and treasurer.

WAUPACA, WIS.—The Baldwin Mills Telephone Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are: E. T. Mather, Charles Rasmussen and Taylor Looker.

Legal.

NO PLANT FOR ORANGE.—The New Jersey Court of Errors, on Nov. 18, handed down a decision in the case of Herbert Lighthipe against the city of Orange, Crocker-Wheeler Company and Western Electric Company. The case was the review of an award by the Orange Common Council for a street lighting plant. The court held that Orange is not within the class of cities in the act of 1906 authorizing such plants. The resolutions and contracts are set aside, and the question of costs reserved. Several months ago the Supreme Court handed down a decision against the city, but the latter took an appeal.

RIGHT OF CITY TO SELL ELECTRIC ENERGY FOR PRIVATE PURPOSES.—A city owning and operating an electric light plant, under a statute empowering cities to provide for lighting the streets, etc., may, after discharging its duty to the public, sell its surplus electricity to private citizens for lighting. So long as the affairs of a city are conducted by its council in a reasonably judicial manner, its acts will not be interfered with by the courts, unless it is transcending its powers, or a clear right has been withheld, or a wrong perpetrated or threatened; and one seeking to restrain a city owning and operating such an electric light plant to light its streets from selling electricity to private persons for lighting must show that the city did not sufficiently light its streets, and that it was financially able to extend its system for lighting its streets. Of course, if the sale of electricity for private purposes resulted in a material impairment of the lighting of the streets of the city, there would be some ground for interference by the courts. Crouch et al. vs. City of McKinney, Court of Civil Appeals of Texas, 104 S. W. Rep. 518.

EDISON PHONOGRAPH.—At Newark, N. J., on Nov. 29, a general denial was filed in behalf of Thomas A. Edison and his co-defendants in the chancery suit brought by John W. Slater and other minority stockholders of the New England Phonograph Company, who claim to have suffered damage by reason of the alleged violation on the part of the defendants of certain alleged territorial license rights of that company. The answer makes reference to similar suits brought against Mr. Edison and the phonograph companies bearing his name, by James L. Andem, who is also one of the complainants in this suit. Mr. Andem was recently arrested on a warrant issued by the United States Circuit Court for the District of New Jersey, charging him with having filed a "forged bill," to which he, as the "pretended secretary of the New England Phonograph Company," attested a blank wafer as being the genuine seal of the company. The Edison answer consists of 46 typewritten pages, to which are added 55 pages of schedules, and goes minutely into the details of the relations of the phonograph companies, and the involved litigation growing out of disputes over the patent rights and business agreements.

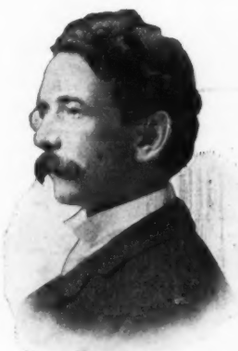
RIGHT OF TELEPHONE COMPANY TO ERECT TELEPHONE POLES IN CITY STREETS.—The owner of property abutting on Townsend Street, in the city of Syracuse, N. Y., brought an action against the Independent Telephone Company, of Syracuse, to restrain that company from erecting a telephone pole in front of his premises and stringing its wires thereon. The ground of the action was that the putting up of telephone poles along that street was not a proper use of the street and that it could not be done without compensating the owners of the abutting property for the additional burden so imposed. The plaintiff's premises were situated within half a mile of the center of the city of Syracuse, which city enjoys a population of over 100,000 persons, and the telephone company was the owner of a franchise granting to it the right to erect its line along the street in question. It was held that the company was making a proper use of the street, and that the plaintiff had no legal cause for complaint. Where the abutting owner owns to the middle of the street, which, as a rule he does, and the street is located in a rural district, and may properly be classed as a country road, the maintenance of a telephone line between the center line and the exterior line of the highway constitutes an additional burden not contemplated by the original dedication of the highway and not within the scope of the public use. And in such rural districts the owners of land abutting on the highway may restrain a telephone company from placing poles in front of their premises, unless the company has secured that right by grant or condemnation. But a distinction has been drawn between city streets and rural roads in New York, and the erection and maintenance of a telephone line along a city street is held by the New York decisions to be within the public easement and a proper street use which cannot be interfered with by the abutting owners. Gannett vs. Independent Telephone Company of Syracuse, New York Supreme Court, 106 N. Y. Sup. 3.

PROSECUTION FOR CUTTING TELEPHONE WIRES UNDER MISSOURI STATUTE.—Two employees of a telephone company were tried and convicted upon a charge of cutting wires of a telephone line owned by a partnership known as "Farmers' Bolivar & Van Telephone Company," and located in Polk County, Mo. The partnership was composed of a number of farmers who had joined for the purpose of operating a local telephone exchange, and they constructed their line so that it crossed the company's line at two places, the wires of the farmers' partnership being strung at some distance above those of the company. The company's employees, feeling that on account of the inferior construction of the farmer's line, the wires might become detached from the poles and fall across the company's wires, and thus interfere with the service of the company to its patrons, determined to provide against such a contingency. This they accomplished by severing the wires. The statute under which the defendants were prosecuted designated the act of cutting telephone wires as a misdemeanor, and on appeal it was shown that a subsequent statute was enacted which raised that offence to the dignity of a felony. Thus the court was confronted by the anomaly of a single act being defined as a misdemeanor in one section of a statute and as a felony in another, and it was argued that the statute under which proceedings were taken against the defendants was repealed by the new statute which made their act a felony. This contention was supported by the court and it was held that, while the defendants' lawless acts could not be defended from any reasonable standpoint, and while the defendants should be adequately punished for what they admitted was a willful and intentional destruction of property of others, the judgment would have to be reversed for the reason that defendants were prosecuted under the provisions of a statute which was no longer in effect. State vs. McKee, Kansas City Court of Appeals, 104 S. W. Rep. 486.

GETTING A SHOCK PURPOSELY.—In the case of Johnston versus the New Omaha-Thomson-Houston Company, the Supreme Court of Nebraska has decided against the plaintiff for contributory negligence. It held that an ordinary bright and intelligent boy, 12 years old, living in a city in which electric light and power wires are in constant use on nearly all the principal streets and highways, who, having knowledge of the danger, but not of its extent, purposely takes hold of such a wire in order to obtain a shock, and is injured thereby, is as a matter of law guilty of contributory negligence. The decision says: "The circumstances of the accident themselves are such that all these questions may be resolved in favor of the plaintiff and still there can be no recovery. There were five boys in the party. One of them climbed upon the fence as if to touch the wire, but his companion 'scared him down.' Then the

plaintiff's son climbed partly up the fence apparently with like intent, and his companions 'scared him down.' Then he told them to go on to one side so as to be out of the way if he happened to fall, and then he climbed up again and touched the wire, and received the shock and consequent injury of which complaint is made. The evidence establishes several things without contradiction and conclusively. Electricity is a mysterious power, but in many of its common manifestations is not, and has not been for many years, an unknown force. It is a matter of common knowledge that electric light and power wires carry powerful and death-dealing currents, and that they are the frequent cause of severe and fatal accidents, and that ordinary prudence requires all persons to avoid contact with them, especially if they are imperfectly or defectively insulated. The evidence establishes conclusively that the plaintiff's son was an ordinarily bright and intelligent lad, 12 years of age, who lived in the city and knew that the wire carried a current sufficiently powerful to light the circuit of which it was a part, and knew that, because of defective insulation or other defect at the place in question, such current was capable of being diverted into the body of any person coming in contact with it, and knew that shortly before that time it had been so diverted, and had thereby caused a shock or injury more or less serious to the person of another boy. That he anticipated an injury of some degree to himself is undeniable, because what he deliberately sought was a 'shock,' which is nothing less than an injury. Whether he also anticipated its extent or degree is not known, but that he supposed that it would be of considerable severity is shown by his caution to the other boys to stand out of danger in case of his fall."

Obituary.



PROF. C. P. MATTHEWS.

PROF. C. P. MATTHEWS.—It is with deep regret that we record the death of this well-known educator at Phoenix, Ariz., on Nov. 23. Charles Philo Matthews was born at Fort Covington, N. Y., Sept. 18, 1867. He received his primary education in the schools of his native town, and entered St. Johnsbury Academy, St. Johnsbury, Vt., in 1885, from which he was graduated in 1887. After a year in business he entered Sibley College, Cornell University, and was graduated with the degree of M. E. in 1892. In 1901 he received the degree of Ph. D. from Cornell, the subject of his Doctor's thesis being "On Certain Photometric Apparatus and the Results Therewith Obtained." After 1892 Prof. Matthews engaged chiefly in teaching physics and electrical engineering, but during vacation periods, and to some extent during term time, took up various kinds of engineering work. The summer of 1892 was passed at the works of the Rockford, Ill., Manufacturing Company, the summer of 1902 in the National Bureau of Standards at Washington, and the winter of 1903-1904 in the Electrical Testing Laboratories of New York City. From time to time he acted as consulting engineer, chiefly on matters in connection with electric lighting. From 1892 to 1896 he was instructor in physics and applied electricity at Cornell University, and in the latter year went to Purdue University, Lafayette, Ind., as associate professor of electrical engineering. In 1902 he became professor of electrical engineering at Purdue, and upon the resignation of Professor W. E. Goldsborough was made director of the School of Electrical Engineering of that university. Prof. Matthews was for four years photometrist for the committee of the National Electric Light Association, appointed to determine the photometric values of arc lamps, during which time he directed all the experimental work and designed the apparatus wherewith to carry it on. These reports, which carry over 200 pages and represent a vast amount of labor, appeared in the transactions and contained the most valuable collection of data on the subject of arc lamp photometry in existence. Prof. Matthews was the patentee of an integrating photometer for determining the candle power of incandescent lamps and other sources of artificial light, which instrument is largely used in laboratories and received a gold medal from the Louisiana Purchase Exposition. Prof. Matthews was also a frequent contributor to the technical press. During the past four years his failing sight had become a matter of deep distress to him, and meant at last, with increasing ill health, the abandonment of all the work in which he was so deeply interested.

MR. E. B. WEBSTER.—Everett Bertram Webster, president of the National Steel & Wire Company, New York City, died suddenly at Windsor Hotel, Jacksonville, Fla., on Dec. 2. His wife reached Jacksonville at 2:20, just after his death. He was a director in the National Steel Foundry Company and the Safety Industrial Wire & Cable Company. He lived in Lynn, Mass., with an uncle, the late Edwin Johnson, who practically adopted him. He started his career as a clerk in the office of Thomas W. Lawson in Boston, which arrangement was terminated with a lawsuit by Mr. Lawson, who charged that Webster had violated a contract with him not to engage in the sale of or promotion of stocks on his own account.

Personal.

MR. THOMAS W. FINUCANE has tendered his resignation as president of the United States Independent Telephone Company, of Rochester, N. Y., and as chairman of the company's executive committee, to take effect immediately.

MR. CHARLES T. McDANIEL, of Omaha, Neb., has been appointed general manager of the Ozark Bell Telephone Company, of Ozark, Mo., succeeding Mr. C. C. Schoen, resigned. Mr. McDaniel was formerly manager of the Nebraska Telephone Company at Omaha.

MR. CASPER E. YOST, president of the Nebraska Telephone Company and of the Iowa Telephone Company, has been elected president of the Northwestern Telephone Company. He will attend to the executive affairs of the three companies at his present office in Omaha.

MR. J. R. VAN DYKE, manager of the Rocky Mountain Bell Telephone system in the Cœur d'Alene district, has resigned, and will engage in other business. He is succeeded by Mr. Fred C. Lewis, acting assistant superintendent under Mr. R. E. Hart, of the Cœur d'Alene branch.

MR. H. J. PETTINGILL, president of the Northwestern Telephone Company for the past three years, has resigned and will devote his entire time hereafter to the Southwestern Telegraph & Telephone Company, of which he has been president for three years. His headquarters will be at Dallas, Tex.

MR. L. H. TAYLOR, who for several years has been connected with the U. S. Reclamation Service, latterly in charge of the Truckee-Carson project in Nevada, and at the head of all geodetic surveys in that state, has accepted a position with the California-Nevada Power Company as supervising engineer. He is at present engaged on plans for reservoir sites in Nevada.

MR. W. B. T. BELT, of Omaha, Neb., has been appointed vice-president and general manager of the Nebraska Telephone Company to succeed Mr. H. Vance Lane, who was appointed president of the Rocky Mountain Bell Telephone Company, at Salt Lake City. Mr. Lane has been with the Omaha & Nebraska Company for 25 years, and has been superintendent for some time, and is succeeded by Mr. A. S. Kelly.

MR. R. A. MacGREGOR, formerly commercial agent of the Wyoming Valley Gas & Electric Company at Plymouth, Pa., has been transferred to the Chicago office of the C. H. Geist Company in the position of manager of the commercial department. The Geist Company controls plants at Michigan City, Valparaiso, Hammond and Plymouth, Ind., as well as the other plant in Plymouth. Mr. MacGregor was formerly with the West Penn. Railways Company. The headquarters of the Geist Company are in the Commercial National Bank Building, Chicago.

MR. R. H. STERLING, of San Francisco, Cal., formerly connected with some of the constituent companies of the California Gas & Electric Corporation, and more recently general manager of the Coast Counties Light & Power Company, at San José, Cal., has been appointed general manager of the American River Electric Company, with headquarters in Stockton, Cal. He will have general charge of the company's hydro-electric plant, transmission system and sub-stations. Col. W. R. Johnson still retains the position as manager of the company's local office in Stockton.

Trade Publications.

VERTICAL GAS ENGINES.—The S. M. Jones Company, Toledo, Ohio, has issued a well illustrated circular devoted to Rathburn vertical gas engines. These engines are built in ratings of from 50-hp to 300-hp in the two-cylinder and three-cylinder types; twin three-cylinder engines are offered in ratings of from 150-hp to 600-hp. The six-cylinder engines are particularly designed for running 60-cycle alternators in parallel.

VITRIFIED CONDUITS.—The Rochester Sewer Pipe Company, Rochester, N. Y., has issued an eight-page folder descriptive of its vitrified conduits, and containing specifications, information and suggestions. The folder shows the various styles of conduits, both single and multiple duct, and gives complete dimensions and weights of each style. It gives a brief summary of the results accomplished in the manufacture of these goods. While very brief, the circular is decidedly interesting.

HUNTING PICTURES.—Mr. John S. Speer, of the Speer Carbon Company, St. Marys, Pa., the well-known manufacturers of the Speer high-grade carbon brush, is sending out to his friends a collection of hunting and fishing pictures. These pictures are 12 x 14 inches, mounted on dark green cardboard, and are exceedingly attractive. Mr. Speer will be glad to send a set of these pictures to any one using carbon brushes, and who will write to him upon the official letter head of the company with which he is connected.

STUART-HOWLAND COMPANY, Boston, Mass., has issued a splendid new catalogue of electrical apparatus and supplies, bound in green and red cloth, gilt lettered. It has no fewer than 784 pages and thousands of cuts, all devices being thoroughly illustrated as well as described and priced. There is no index, but all the articles are grouped and the classes follow each other alphabetically. It is altogether a most admirable, creditable and useful publication. A discount sheet that is issued with the book, has 15 pages of indexed articles, referring in each instance to the page in the catalogue.

TESTING GENERATORS.—Allis-Chalmers Company, of Milwaukee, Wis., has just issued Bulletin No. 1037 on "Testing Alternating Current Generators." The method described is that perfected by Mr. B. A. Behrend, chief electrical engineer of the company, and allows the most important data to be obtained as to performance while the machines are still in the shop, the machines being subjected to full load conditions without putting them under full load. A copy can be obtained by any electrical engineer on request.

H. B. CAMP COMPANY, New York, Pittsburg and Chicago, has just issued another of its clever broad sheets, illustrative of the modern use of the telephone as compared with older methods of communication. It is got up like a large etching with tone background, and black paper mount, and is entitled, "From Waterloo to Mukden." A Japanese field officer is shown with map on his knee, using the telephone while a shadowy Cossack flees in the background. In the lower corner is a block of Camp conduit and the name of the company. The whole thing is very clever.

PORTLAND CEMENT.—An effective pamphlet has been issued by the Lawrence Cement Company, 1 Broadway, New York, in the interest of "Dragon" Portland Cement. In addition to instructions in detail for the application of hydraulic cement to numerous purposes, many well-engraved illustrations appear of buildings in whose construction "Dragon" cement was used, including concrete buildings. To catalogue makers the pamphlet will be of interest because of its cover design, an excellent effect being produced by simple but artistic means, as contrasted with the garish use of colors and draftsmanship on the usual catalogue cover.

WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has just isued a handsome quarto descriptive catalogue in green and gray paper cover, devoted to its electrical instruments of precision. It is Bulletin No. 79, and contains 32 pages, with a large folder of the scales employed in various types. It is now some ten years since the Wagner Company took up the design of alternating-current switchboard instruments for central-station work. This line has been followed up and worked out, and to it have been added direct-current instruments of equal reputation and merit. To all these the catalogue devotes space, as well as to detail apparatus such as compensators, instrument transformers, etc. A large amount of instructive data is crowded into the catalogue.

ELECTRIC LOCOMOTIVES.—"The Electric Locomotive in Heavy Passenger and Freight Work" is the title of Bulletin No. 4537, recently issued by the General Electric Company, Schenectady, N. Y., in which is described a large number of present and proposed locomotives built and planned by the company. Sketches are given of locomotives ranging from 17 to 150 tons for all classes of service, including mining, high-speed passenger, slow-speed freight, mountain-grade trunk lines, etc. Electrical and mechanical data are given and characteristic curves for each locomotive are shown. A short preface describes the reasons for the growing demand of electric traction, and gives interesting facts regarding the construction and characteristics of the General Electric heavy traction motors and locomotives, with figures relative to the saving effected by the substitution of electric for steam traction in both passenger and freight work. Bound in a flexible brown cover, the publication forms a ready reference book on the subject.

SINGLE-PHASE MOTORS.—The field for single-phase motors of moderate capacity is constantly growing by reason of the increasing tendency of central stations to generate polyphase current and feed a large portion of the lighting load through single-phase distribution. The General Electric Company, Schenectady, N. Y., has perfected a simple and substantial motor for this class of service. It is known as the Type IS, form KG, and is described in Bulletin No. 4545. The bulletin illustrates various sizes, describes the details of construction and operation, shows forms of starting boxes, and gives a large amount of general information, useful and important to power users. The motors are well adapted to the operation of all kinds of machines, by the use of belts and gears, and may be directly connected to loads requiring moderate starting torque. Clutch couplings and pulleys are used where the apparatus is required to be started under load. The motors are wound for standard voltages and frequencies.

CONCENTRIC AND INVERTED DIFFUSERS.—In order to improve the distribution of light from enclosed arc lamps and adapt them to severe requirements, the General Electric Company, Schenectady, N. Y., has introduced the concentric light diffuser. Bulletin No. 4542, recently issued by the company, describes the device and illustrates many of its applications. It consists of a suitably designed metal diffuser attached to a lamp casing in the same manner as an ordinary reflector or shade. In place of an outer globe, a screening shade is used, which performs the double function of subduing the light directly under the lamp and reflecting a portion of it on to the diffuser. Some of the advantages claimed for this method of illumination are that the light is white, even and well distributed; that it does not tire the eyes; that the illumination is particularly adapted to the matching of colors, and that the nature or color of the ceiling does not affect the character of the illumination. Inverted diffusers have been designed to meet the demands which exist for a reflector producing a more concentrated illumination, and are used without the lower screening shades. The bulletin gives a partial list of the many installations in department stores, factories, machine shops, armories, public halls, colleges, etc., where the apparatus is in use, and includes some important data on the subject of arc lighting.

Business Notes.

THE HELIOS MANUFACTURING COMPANY, builder of arc lamps and storage batteries, has moved its New York office from 18 East Forty-Second Street to the World Building, Park Row.

THE WESTERN ELECTRIC COMPANY, of Chicago, Ill., has leased the old quarters of the First National Bank, at Third and Walnut Streets, Cincinnati, Ohio, where it will locate a branch office in that city.

ELECTRIC SERVICE SUPPLIES.—Mr. R. G. Widdows, formerly associated with the Cutter Company at Pittsburg, has recently been added to the staff of the Electric Service Supplies Company, of Philadelphia, as a city salesman.

THE D. M. STEWARD MANUFACTURING COMPANY, whose factories are at Chattanooga, Tenn., and Toronto, Canada, has opened a New York office at 66 West Broadway. It is now in a position to give special attention to its New York customers from this office.

COLUMBIA LAMPS.—The Columbia Incandescent Lamp Company, of St. Louis, Mo., has opened a New England branch office at 280 Devonshire Street, Boston, where it proposes to carry a full assortment of lamps in stock for the service of its trade in that territory.

COMMUTATOR TRUING DEVICE.—Announcement has just been made that Jordan Brothers, 74 Beekman Street, New York City, have been awarded a silver medal diploma for their exhibit of the Jordan commutator truing device at the Jamestown Exposition, 1907. This award is the highest in its class. As is well known, the Jordan device trues commutators without removing the armature. The device can be attached to any machine. It consists of a grinding wheel set in ball-bearings and equipped with appropriate clamps whereby it can be fastened to a rocker arm or the motor frame, or the outboard bearing, according to the type of the dynamo or motor. The grinding wheel, which is of carborundum, contains no emery, and so cannot injure the commutator. The device is bolted in position so that its shaft is parallel to the face of the commutator and the grinding wheel just clears the commutator. It saves labor and time and increases the life of the commutator threefold. Among some users are the Holtzer-Cabot Electric Company, Brookline, Mass.; Canadian General Electric Company, Limited, Toronto, Canada; Caruthersville Ice & Light Company, Incorporated, Caruthersville, Mo.; Tennessee Lumber Manufacturing Company, Sutherland, Johnson County, Tenn.; Chambers Electric Light & Power Company, Truro, Nova Scotia.; Central Massachusetts Electric Company, Palmer, Mass.; Samuel J. Shimer & Sons, Milton, Pa.; John Van Benschoten, Poughkeepsie, N. Y.; Kuehn Electric Company, Canton, Ohio; Colgate & Company, New York City.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutical Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS & ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New England, Philadelphia, Pittsburg and Chicago. Meetings in New York, second Thursday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles West. Next meeting, Chicago, January 21, 22 and 23, 1908.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

MISSOURI STATE ELECTRIC LIGHT ASSOCIATION. Secretary, C. Z. Pierson, St. Charles, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn. Next meeting, Chicago, January 21, 22 and 23, 1908.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Charles W. Ford, Oklahoma City, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 26, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

871,772. SEALING FOR ELECTRIC APPARATUS; James R. Baker, Arlington, N. J. App. filed March 31, 1905. A device for preventing mercury entering the sealing-off tube of a vacuum lamp and breaking the same in transit. Has a small ball which is crowded into the tube by a wire connection.

871,804. APPARATUS FOR ELECTRICALLY OPERATING WATER-TIGHT BULKHEAD DOORS; Robert H. Kirk, Cleveland, Ohio. App. filed April 22, 1905. A complete installation for the purpose of controlling water-tight bulkhead doors from a local or a remote point. Includes both electrical circuits and mechanical construction.

871,826. ELECTRIC TRAIN LIGHTING SYSTEM; Walter Scribner, Columbus, Ohio. App. filed Jan. 12, 1907. System for lighting a train from a dynamo carried by the wheel axles and including storage batteries with automatic means for shifting the connections to accord with the speed and direction of the dynamo.

871,851. FUSE; Frederick W. Young, East Orange, N. J. App. filed March 14, 1907. Provides a fuse which will open the circuit in any system having either a high or a low voltage, without subjecting the internal parts thereof to any flame, the arc being extinguished as soon as formed, by the use of which high-tension systems may be brought into safer limits.

871,904. SHAFT OSCILLATOR; Edwin C. Wright, Newport, Ky. App. filed April 20, 1907. An ironclad magnet is embodied in attractive relation to the end of the shaft and circuit-closing means is arranged to intermittently energize the same so as to vibrate said shaft. The switch is controlled by the combined longitudinal and rotary movements of the shaft.

871,913. TROLLEY WHEEL BEARING; William M. Casewell, Warren, Pa. App. filed June 6, 1907. The trolley wheel bearing has an oil cup disposed therein so as to prevent the oil from running out of the bearing when the trolley wheel leaves the wire and the pole flies upwardly to a vertical position.

871,947. PROCESS FOR THE MANUFACTURE OF WHITE LEAD; Frank W. Morris, Victoria, British Columbia, Canada. App. filed Dec. 28, 1906. Relates to a process for manufacturing carbonate of lead; produces formic acid by electrolytic action and utilizes said acid in the subsequent reactions.

871,948. PROCESS FOR THE MANUFACTURE OF CYANID OF POTASSIUM OR SODIUM; Frank W. Morris, Victoria, British Columbia, Canada. App. filed Dec. 28, 1906. Relates to modifications of the above process for making cyanid of potassium.

871,960. SIGNALING SYSTEM; Wilmer W. Salmon, Buffalo, N. Y. App. filed Aug. 29, 1905. Details of signal system having sectionally energized track rails and polarized relays operated by the short circuiting of local batteries by the wheel axles.

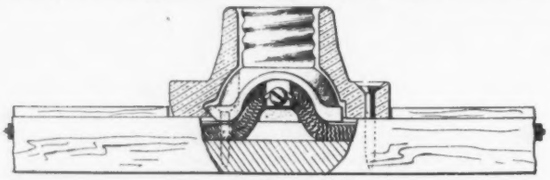
871,970. SYSTEM OF MOTOR CONTROL; Emmett W. Stull, Nor-

wood, Ohio. App. filed March 31, 1906. Provides for cutting out injured or disabled motors from a circuit without affecting the action of the controller upon the remaining motors; has a unitary cut-out switch for cutting out either pair of motors.

871,971. ELECTRIC FURNACE; Edward R. Taylor, Penn Yan, N. Y. App. filed Sept. 5, 1906. Provides a furnace adapted to work on a relatively small scale when desired. Relates to a previous patent, 638,364.

871,994. CABLE TERMINAL AND JUNCTION BOX; Frank B. Cook, Chicago, Ill. App. filed July 9, 1906. A cable terminal comprising an inclosed box made of sheet metal, a removable cover for the front of the box, suitable fanning strips secured to the rear of the box, and suitable protective devices mounted on the said box and fanning strips.

871,994. METHOD OF CLEANSING METAL; Jean Hawthorne, New York, N. Y. App. filed March 26, 1907. Designed to clean metals



872,029.—Molding Receptacle.

without undue rubbing or manual work; consists in converting the oxide on the surface into metal.

872,002. RAILROAD SIGNALING DEVICE; Burns S. Miller, Everett, Wash. App. filed May 4, 1907. Patentee erects a barrier at a point where a landslide is imminent, and has mechanical connection therefrom to an adjacent semaphore signal.

872,022. DOOR FASTENER AND OPENER; Charles Smith, Boston, Mass. App. filed April 24, 1907. Relates to an electric lock of the type in which the key is concentrically insertable in the doorknob.

872,029. MOLDING RECEPTACLE; James S. Stewart, New York, N. Y. App. filed June 29, 1906. A molding receptacle formed essentially of one piece of porcelain having certain metallic clips and parts assembled therewith and which is adapted to properly guide the circuit wires into a position to make the connections so that they are always accessible, and yet conformable to the insurance regulations.

872,063. SUPPORTING AND CONVEYING APPARATUS; Henry L. Hollis, Chicago, Ill. App. filed May 22, 1906. Supporting and conveying mechanism for use in electrolytic work for conveying plates to be treated from one position to another. Makes use of a trolley carrier and specially constructed tackle.

872,065. INCANDESCENT LAMP CLUSTER; Harvey Hubbell, Bridgeport, Conn. App. filed Oct. 13, 1905. A cluster lamp receptacle having a porcelain body with radially extending holes and a central cavity with a metallic washer which constitutes a common central stud terminal for the lamps.

872,094. TROLLEY SECURING DEVICE; John Szekeres, Pittsburg, Pa. App. filed Aug. 23, 1907. Patentee has a complete rectangular frame surrounding the trolley wheel with upwardly extending swiveled hooks which close over the wire.

872,102. ELECTRIC STOP FOR ENGINES; James K. Wright, New York, N. Y. App. filed Feb. 4, 1907. Relates to engine governing mechanism in which a valve operates to cut off the steam supply when the speed varies in either direction beyond predetermined limits.

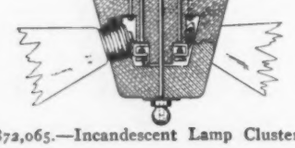
872,126. MASSAGE IMPLEMENT; Henry G. Hart, Mount Vernon, N. Y. App. filed May 15, 1905. A massage implement having a revoluble cage with circumferential rollers and connected in an electric circuit.

872,142. RAIL BOND; Asa H. Mosher, Westfield, N. J. App. filed Jan. 17, 1907. The bond is received in a conical plug with an eccentric hole and slotted on one side so as to be driven into binding or wedging relation on the bond.

872,143. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; Martin B. McLauthlin, Malden, Mass. App. filed Sept. 22, 1902. Relates to a complete elevator system, including winding drums, brakes, slack cable controller and pilot circuits.

872,145. PROTECTIVE SHIELD FOR SKELETON FRAME BELLS; George L. Patterson, New York, N. Y. App. filed July 11, 1907. A bell having a skeleton frame and a protecting shield with means for securing the same at the back of the frame. A water shed is provided for the shield.

872,146. ADJUSTMENT FOR CONTACTS; George L. Patterson, New York, N. Y. App. filed July 11, 1907. A construction of vibrator



872,065.—Incandescent Lamp Cluster.

having the post or frame member vertically slotted to contain the thumb-wheel which surrounds the vibrator screw.

872,148. ELECTROTHERAPEUTIC APPARATUS; Nelson H. Raymond, Brooklyn, and Joseph C. Vetter, Coney Island, N. Y. App. filed Aug. 24, 1905. Electrotherapeutic apparatus for home use, including cylindrical casing having an induction coil and an additional cylindrical casing containing a battery, and connected so as to form the respective terminals of a circuit.

872,154. COMBINED CONTROLLER AND CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed April 9, 1907. Provides a circuit controller in combination with a starting switch, or the like, which shall respond during the starting period only to current which is excessive for starting currents, and which shall respond during running period to current which is excessive for running currents.

872,171. MEANS FOR PROTECTING OPERATORS' RINGING LEADS; William W. Dean, Elyria, Ohio. App. filed April 7, 1906. A means for protecting operators' ringing leads comprising a high resistance relay therein which is normally inoperative, and a low resistance shunt around said relay and controlled thereby.

872,193. ELECTROCAPILLARY APPARATUS; Axel Orling, Upper Totting, England. App. filed June 1, 1907. Electrocapillary apparatus in which two dissimilar liquids are arranged to make contact with one another within a capillary passage, and in which an electric current is adapted to be transmitted or electrical impulses passed from one liquid to the other, producing a displacement of the liquids and their meeting surface.

872,197. ELECTRIC SWITCHING DEVICE; James A. Posey, Midlothian, Tex. App. filed March 3, 1906. Complete electrical track switch, including a movable trolley section displaced by the wheel and closing or opening the circuit of a solenoid, which has contacts for energizing either of a pair of electromagnets operating the switch point.

872,204. APPARATUS FOR FUMIGATING TELEPHONE INSTRUMENTS; Louis I. Shrader, New Albany, Ind. App. filed May 29, 1907. A fumigator for telephone instruments comprising a casing provided with a receptacle for a fumigating agent, and also having an opening for the mouthpiece of a telephone transmitter, the said casing being adapted to be locked to and carried by the transmitter head through the intermediary of said mouthpiece, and said casing also having an opening for embracing the telephone receiver body with the hearing end thereof interior to the casing.

872,208. INCLOSED RESISTANCE; Henry J. Wiegand, Milwaukee, Wis. App. filed Oct. 30, 1905. The resistance wire is wound on a hollow insulating core and embedded in plastic material within a sheet-metal casing.

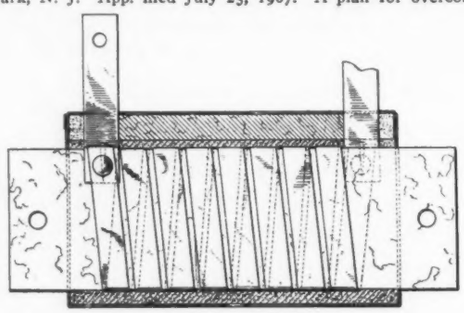
872,209. INCLOSED RESISTANCE; Henry J. Wiegand, Milwaukee, Wis. App. filed Oct. 30, 1905. An inclosed resistance comprising a resistor, a casing therefor, and an insulating supporting member having said casing carried thereby.

872,213. BATTERY SUPPORT FOR AUTOMOBILES; Samuel R. Bailey, Amesbury, Mass. App. filed Jan. 4, 1907. The battery box depends from the automobile chassis by four depending links having ball-bearing connections at their ends. The links are spring extensible to furnish a yielding support for the battery.

872,215. AUTOMATIC ELECTRIC SWITCH; William L. Bliss, Brooklyn, N. Y. App. filed Jan. 6, 1905. A car-lighting system operated from a dynamo on the wheel axles and having a storage battery permanently bridged across the line and a cut-out switch for interrupting the series circuit of the dynamo.

872,216. INSULATOR; Homer D. Bodley, Stanley, N. Y. App. filed Feb. 27, 1907. The insulator is provided with an overhanging ledge constituting a jaw with which co-operates a movable jaw impelled by a cam wedge.

872,228. QUADRUPLEX TELEGRAPH SYSTEM; John J. Ghegan, Newark, N. J. App. filed July 25, 1907. A plan for overcoming the



872,209.—Inclosed Resistance.

false signal of a quadruplex telegraph system. Has means controlled by the armature of the neutral relay to momentarily open the local sounder circuit of the neutral relay to prevent false signal.

872,251. ELECTROMAGNETIC POWER GENERATOR; Joseph L. Potter, Indianapolis, Ind. App. filed July 16, 1906. Relates to power generators of the type in which a single armature is employed to operate opposite to a plurality of electromagnets to be influenced first by one or more of the electromagnets and then in succession by the others.

872,283. INCANDESCENT LAMP SOCKET; Gilbert W. Goodridge, Bridgeport, Conn. App. filed July 20, 1907. Has the parts which are usually connected by a bayonet joint, both corrugated and telescoping together and having means by which they interlock.

872,284. TRANSMITTER; Rasmus Hanse, Chicago, Ill. App. filed Dec. 3, 1902. In a telephone transmitter, the combination of a chamber for granular material, carried by the casing, a main diaphragm situated behind said chamber, a supplemental diaphragm carrying an electrode located in said chamber, and a connection between the main and supplemental diaphragms, substantially as described.

872,289. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; Edward D. Lewis, Elmira, N. Y. App. filed June 18, 1907. Provides means by which the motor field will be saturated in advance of the armature, the armature being entirely cut out during this initial saturation of the field so as to produce a quick and strong starting torque.

872,293. RINGING DEVICE FOR TELEPHONE EXCHANGES; William W. Dean, Elyria, Ohio. App. filed Aug. 8, 1906. An automatic ringing device for telephone systems, comprising a ringing relay having line and generator connections, an operator's key adapted to momentarily close the relay circuit, short-circuit contacts controlled by the relay so that when energized it will lock itself, and non-inductive means controlled by the wanted subscriber to break the relay locking circuit, substantially as described.

872,298. MEANS FOR AUTOMATICALLY CONTROLLING ELECTRIC MOTORS; H. Ward Leonard, Bronxville, N. Y. App. filed Jan. 28, 1902. Renewed July 10, 1905. The combination of an electro-motive force in series with the armature of the motor and a regulator controlled by the work for automatically controlling the electro-motive force of said source to automatically increase or decrease the speed of the motor to meet the requirements of a variable duty.

872,300. ELECTRICAL MEASURING INSTRUMENT; Paul MacGahan, Pittsburg, Pa. App. filed Oct. 18, 1905. Provides a single portable instrument for measuring the drop in potential and the power consumed in an incandescent lamp.